

JOINT DOT-NASA
CIVIL AVIATION R & D POLICY STUDY

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INSTITUTIONAL FACTORS IN CIVIL AVIATION

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PREPARED BY
A. D. LITTLE INC.
CAMBRIDGE, MASS.

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FOR THE

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16. Abstract <p>The objectives of the study are to identify institutional factors which are constraining the civil aviation R & D process by which new or improved systems and equipment are developed in response to civil aviation needs; to postulate options to remove or attenuate these constraints; and to discuss the advantages and disadvantages of choosing any given option in order to help guide national policy-makers.</p>			
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FOREWORD

This study, contract number DOT-OS-00083, was performed over the period from July through November 1970. Technical performance cognizance by the Civil Aviation Research and Development Policy Study was the responsibility of Mr. Stanley Smolensky of the Office of Policy Planning, National Aeronautics and Space Administration. His guidance and constructive comments throughout the effort were invaluable.

Primary responsibility for major sections of the study was assigned to Dr. Alan D. Donheiser, Mr. Thomas G. Miller, Jr., both senior professional staff members of Arthur D. Little, Inc., and Mr. Nathan S. Simat, our subcontractor and President of Simat, Helliesen and Eichner, Inc. Additional Arthur D. Little, Inc. staff members who made substantial contributions to this effort include Mr. Charles Y. Chittick, Jr., Mr. Michael D. Dawson, Mr. Raymond V. Gilmartin, Mr. Maurice M. Henkels, Mr. Dwight C. Macauley, Mrs. Robin Millstein, Mr. Jeffrey W. Traenkle, and Mr. Bruce Whelple of Simat, Helliesen and Eichner.

Within Arthur D. Little, Inc. a study review group composed of General James M. Gavin, Chairman of the Board, Mr. Martin L. Ernst, Mr. Theodore P. Heuchling, and Mr. John R. White, all vice presidents of our company, was led by Dr. Bruce S. Old, Senior vice president who also maintained close contact with the day-by-day progress of the study.

The Project Director of the study was Mr. Robert C. Fraser, who had final responsibility for both the technical content and management of this effort.

TECHNICAL PREFACE

1. BACKGROUND

This is the final report on the findings of Arthur D. Little, Inc., and its subcontractor, Simat, Helliesen and Eichner, Inc., in the performance of contract DOT-OS-00083, initiated early in July 1970, to study "Management and Finance Options" for the Joint DOT/NASA Civil Aviation Policy Study. The findings reported herein are the product of an exhaustive interview program begun early in July, 1970, and an extensive analysis of the existing literature and studies on the subject. The final report follows an earlier interim report presented to the DOT/NASA Joint Study Group on September 1, 1970, and develops and revises the tentative conclusions found therein. The ADL final report is one of several written by various subcontractors for the Joint Study¹ which has the responsibility of coordinating findings and ultimately presenting them to their respective parent agencies.

2. PURPOSE AND SCOPE

The objectives of the study are: (1) to identify those institutional factors which inhibit the civil aviation R&D process by which new or improved systems and equipment are developed, implemented, and ultimately operated in response to civil aviation needs; (2) to postulate alternative means (options) to remove or attenuate these inhibiting constraints; and (3) to discuss the advantages and disadvantages of choosing any given option in order to help guide national policymakers.² Considering this last objective, we believe that the purpose of the study is to identify options available to the Federal Government to insure that the civil aviation technology base of the nation is not being handcuffed, either by constraints or an absence of incentives, in fulfilling its potential to: (1) meet the needs of domestic civil air transportation, and (2) to make significant contributions to securing broader national goals (e.g., full employment, economic and regional growth, satisfactory balance of payments, international civil aviation leadership, etc.).

-
1. Joint Study, Civil Aviation Research and Development (CARD)
 2. Discussion of options in terms of "scenarios" has been eliminated by mutual agreement between the ADL and CARD study staffs.

Since ADL has been asked to identify “institutional” constraints, its definition is central to understanding the report. Institutional is defined here as the process by which civil aviation needs are translated into operating systems and equipment. This process is determined by those formal rules governing the behavior of the civil aviation community, including legislative and regulatory matters; the structure of federal, state and local government and their agencies; and practices and procedures relating to certain fiscal and financial matters. It is also impacted by more elusive “informal” rules such as public opinion, government and private industry attitudes and perceptions, and managerial organization and behavior. Clearly, certain technological developments also constitute serious constraints on the capacity of the R&D process to satisfy aviation system needs. However, the “systems” evaluation components are outside the scope of our contract and will be dealt with elsewhere by the Joint Study.

3. STUDY STRUCTURE

The report has been divided into four major sections including: (I) Overall Findings; (II) R&D Management; (III) Legislative and Regulatory Factors; and (IV) Subject Area Reports. The first section presents a synthesis and enumeration of ADL research findings; the most comprehensive constraints and broad classes of options are identified and discussed. In Sections II-IV, more specific constraints and options are examined in greater detail. The R&D management section defines the R&D problem, and indicates ways in which government and industry are not meeting the research challenge. In the legal and regulatory section two separate approaches to the problem are made. First, the commercial airline industry and its key interfaces with government are examined in order to evaluate the R&D implications of an historically close-knit private-public sector operation. Second, the complex question of airport development is discussed against such issues as fragmented governmental responsibility, limited franchise or service areas, and the growing negative community image of large urban airports. In the subject area reports, an examination of commercial helicopter operations, air cargo, STOL and general aviation provides numerous examples of the difficulties facing civil aviation R&D.³

Institutional constraints are difficult to identify and discuss without recourse to concrete examples of how technology has been restrained in finding solutions to specific problems. It is particularly difficult to appraise institutional constraints in the absence of clearly defined goals for aviation systems. Therefore ADL selected, in consultation with the Joint Study Group, a series of subject area studies that would expose and illustrate most of the important constraints inhibiting the civil aviation R&D process.

3. Two earlier subject area reports, “Airline Profitability and Long-Haul,” and “Airports” have been incorporated into the “Legislative and Regulatory Factors” section.

Much of the material in the subject area reports was developed from more than 175 field interviews. Interviewees included suppliers and customers of civil aviation R&D, government at both the federal and local level, and universities and other participants in civil aviation. The subject area reports were then interpreted by ADL industry specialists, and additional analyses were compiled based on examinations of existing legislation, regulation, and financing. Out of this came comprehensive reviews of the R&D management process at the federal level, and the legal and regulatory process as constraints on civilian aviation R&D.

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SECTION I

INSTITUTIONAL FACTORS IN CIVIL AVIATION: OVERALL FINDINGS

INSTITUTIONAL FACTORS IN CIVIL AVIATION: OVERALL FINDINGS

1. INTRODUCTION

a. Major Aviation Problems

Many of today's aviation problems are well-known; however their basic causes and remedies are not as well understood. The air traveler experiences inconveniences; the aeronautical engineer and the aviation machinist find themselves unemployed; and the community remains at loggerheads over decisions to site a new jetport. The daily newspaper frequently notes many of these aviation-related problems. Some of the problems being headlined are the following:

- The aircraft industry and its major suppliers are financially distressed, but the financial community seems unresponsive to their capital needs; the survival of the industry as it is constituted today is therefore questionable. Many thousands of persons have already been laid off and more are scheduled to follow. In 1969, aircraft manufacturers including engine producers employed approximately 600,000 people — therefore, their problems are of national importance.
- The U.S. airline industry experienced deep and widespread financial losses in 1969; these losses have persisted throughout the first three quarters of 1970 with no sign of improvement for the rest of the year. The airlines, which transported 159 million passengers last year, employ almost 450,000 people — they are also laying off employees.
- Airspace congestion in major terminal areas, airport ticketing and baggage retrieval delays, full parking lots at airports, and occasional but widely publicized aircraft accidents are all highly visible manifestations of "aviation problems" to the air traveler and to businessmen who are information-dependent and in constant need of face-to-face confrontation.
- Unacceptably high operating costs of short-haul air transport compared with revenues (fare levels) have focused air carrier interest almost entirely on longer-haul routes as the road to profitability, if not to survival itself. Consequently, the problem of short-haul transport (moving air passengers

over distances under 600 miles) is not receiving the attention it deserves as the largest segment of the entire airline market.

b. What Can Be Done About Aviation Problems Through R&D?

Although R&D can do a great deal, it is not *the* panacea. The root causes of aviation problems go deeper than simply not having appropriate hardware or software systems; institutional obstacles constrain the flow of technology into civil aviation. Thus, solutions through R&D may be considered only after certain prerequisite issues are addressed. For instance, is the cost of new R&D and systems implementation too large when compared with the alternatives foregone in other fields of human endeavor? Can the civil aviation R&D effort secure priority from a nation having limited resources and other pressing needs? Having then secured some level of resource support, how should these limited resources be managed and applied? An effective strategy for insuring the appropriate level of resources for R&D seems needed along with the capability to manage them for greatest effectiveness.

Hence, the object of this study must be to identify relevant portions of the political, managerial, socio-economic and legal structures that affect aviation development, and determine which societal rules and values prevent us from resolving identified problems. How, if at all, might a restructuring be implemented so that we can address the problems in a more productive way within the framework of our traditional national values?

The accomplishment of this assignment involves numerous subjective appraisals of our inferred national goals and values. Aviation is only part of the nation's transportation problem, and transportation is after all only one of many essentially instrumental functions that must compete for both consumer and taxpayer dollars. The design of an aviation R&D policy that ignores such realities could be patently worthless.

We also recognize that we cannot make final determinations on the political feasibility of the options presented in the study. Therefore we have attempted to temper our analysis and our discussion of the options with "common sense," and have left the final determination of political feasibility to the policymakers themselves.

2. CATEGORIES OF CONSTRAINTS AFFECTING THE CIVIL AVIATION R&D PROCESS

a. Recognized Needs for New Civil Aviation Technology Have Not Been Translated into Effective Market Demand

Effective market demand involves the readiness of people to pay for what they want (their needs), and the willingness of producers to commit resources to satisfy those needs. There is a disparity between established civil aviation needs for new technology and their satisfaction; recognized needs for new aviation technology have not been translated into a clear market to which private enterprise can respond. Without definite markets that offer an opportunity for gain commensurate with the risks involved, private industry has rationally avoided directing its resources toward meeting needs such as the "short-haul market," "the airways market," or the "airport access market."

The need for improved airport access has not been translated into a visible market with profit potential; thus private industry has not invested its resources to satisfy this need. The lackluster financial performance of urban mass transit in the country has discouraged potential energizers; costs of a fixed right-of-way system are high, and a lack of market deters producers from addressing the required R&D; the people who want improved airport access are probably too few to be willing to pay a fare set on a full cost reimbursable basis. It seems doubtful that private enterprise will perceive a market for fixed right-of-way access systems to airports — in terms of making a reasonable return on investment — if it must build *and* operate the system.

A complete STOL system has long been discussed and studied as a possible solution to the country's growing short-haul transportation needs, yet it has not become a reality. No producer of any segment of a STOL system can see a market for his own product until there is assurance that all other elements of the system will be available when his is ready for sale. The total costs of the entire system must be reasonable if the fare structure is to be within reach of enough air passengers to produce a sufficiently large demand to support profitable service. No responsible participant in the system can estimate confidently what the total costs might be — or more importantly, what his share of the total cost burden might be. In the face of so many uncontrollable and unknown variables, no producer of any segment of a STOL system is willing to risk investing in it.

In ATC one encounters traffic congestion, increased travel delays, controller strikes and slowdowns, increased incidence of near misses, delays and

overruns in the automated national airspace systems; all clearly indicate that the nation's air traffic management system is not able to keep up with the demands of civil air commerce.

The issue clearly is not whether needs do or do not exist, but *why* these needs are not being adequately met. Where established needs exist, institutional factors have often inhibited the development of an effective response, both by preventing the emergence of a firm and visible market for the need, and by limiting the resources of potential suppliers (including the R&D community) to produce, and users to acquire new technology.

**b. The Translation of Recognized Needs into Effective Market
Demand is Inhibited by a Web of Institutional Factors**

The principal institutional obstacles to the flow of new technology into civil aviation may be categorized as attitudinal, political, and financial. Clearly, there is a great deal of overlap among these categories. A constraint which is manifested as financial, may actually stem from political factors, i.e., a certain law or regulation. However, by categorizing constraints, although imperfectly, the search for options to remove them is facilitated.

In this section of our report, airports and STOL systems have been used to illustrate a number of constraints. Certainly these are not the only problem areas in civil aviation; but since they illustrate the overlap and interrelationship of institutional constraints, and because of their obvious importance, they have been discussed frequently.

- *Attitudinal or social factors* are those based on attitudes that people have adopted, whether for sound reasons or not. Because attitudes are often deep-rooted and irrational, they are difficult to change. Two important attitudinal factors, constraining the development and implementation of new technology, are the widespread conviction that air transportation is important to only a small segment of the population; and that aircraft are noisy, a threat to the safety of populated areas, contribute to traffic jams, and create other objectionable conditions. Improvement of the civil aviation system is indeed constrained by lack of a broad constituency.
- *Financial factors.* Certain financial factors are transitory, due to cyclical business patterns, while others are of a more permanent nature. The most important financial factor currently impeding the R&D process is the depressed economic

condition of both the aerospace and airlines industries. The aerospace industry is less willing and able to commit resources to new technology; the airline industry is less able and willing to acquire and implement new technology. The impact of financial factors within industry may become more deleterious, through managerial deficiencies, stemming from individual inadequacies, organizational inefficiencies, or lack of appropriate incentives.

- *Political factors* are those stemming from legislative and regulatory policies. Of course, they are ultimately based on attitudes. But because they are generally codified, in the form of enabling legislation or regulatory policy documents, they are subject to more finite solutions, to the extent that specific legal revisions can be identified as goals for their resolution. Managerial policies and procedures are also included in this category. These practices encompass behavior that is discretionary within existing legal and regulatory parameters, and behavior specified by law and regulation. In many cases, it is difficult to separate managerial behavior into distinct casual groups.

c. Attitudinal Factors

- *A major obstacle inhibiting the translation of civil aviation needs into effective market demand is aviation's limited political constituency. This reality must be considered in evaluating the likelihood that major new or revised legislative, regulatory, or financial programs are politically feasible.*

Except for sport or pleasure purposes, flying is essentially a means of getting somewhere. A person travels by air to complete a business transaction or enjoy a vacation. Because of this role, and the fact that alternative transportation means exist, it cannot be expected that civil aviation will be valued by society as highly as new homes, for example.

In fact, civil aviation is unpopular with many. Growth of civil aviation has been accompanied by increasing and severe resistance to the expansion of aviation activities. Consequently, aircraft movements at many major airports have been restricted during certain hours of the night. In response to community demands to reduce noise and objectionable factors arising from aircraft operations, other airports have limited operations to smaller aircraft. At least one

community has petitioned the Civil Aeronautics Board to limit further air services, because airport noise was already exceeding acceptable levels.¹

Civil aviation suffers because the broad benefits of a developed manufacturing and transportation industry are not fully perceived by the public. About half of the adult population now has traveled by air. Increasingly, air travelers are drawn from even the lowest income groups. But, the importance of civil aviation's contribution to the growth and welfare of the nation and the community still lacks visibility to a large segment of the general populace. This contrasts with highway transportation, for instance, where the utility of the automobile and the need for public highways are more universally accepted and ingrained in public policies at the national and local levels.

The fact that aviation always has been a concern of government mainly through a mixed pattern of regulations, subsidies, and support of research, means that many key decisions affecting the fortunes of the industry will be made in the political rather than the market arena. The removal of institutional constraints on aviation, therefore, involves the building of political constituencies. In other words, market demand alone is not sufficient to drive the public-private aviation industry to technologically improved systems. If people generally view air travel as an elitist transport mode, and airports as objectionable neighbors, it will be difficult to generate enthusiasm for projects that involve relieving constraints through institutional change. Furthermore, it may be almost impossible to assemble the power to override the practical veto of interests opposed to such changes. Thus, the reversal of local determinations by a hypothetical super-federal civil aviation agency would be unpopular, and the agency would probably be powerless to deal with an aroused citizenry.

It is essential to remember that civil aviation is only one of many national needs; therefore, aviation proponents must not lose perspective in proposing solutions to aviation problems. Secondly, the proponents must seek and support proposals that creatively blend aviation benefits with those generated by other governmental programs in multiple-use projects. This concept is expanded in Section II, "Regulatory and Legislative Factors," and in a proposed option, discussed later in this section.

1. The city of Long Beach, California went on record in the *Pacific Northwest-California Investigation*, Docket 18884, against further service, stating, "... the City does not want to be designated on any certificates. It opposes implementation of service... in this case and we will not make terminal space available. [T]he main factor... is noise... Hopefully, when engines become less noisy, we can accommodate sufficient service..."

The prime consequence of aviation's limited political constituency is the constraint on airport development. Although the last decade has witnessed unparalleled growth in airline traffic and major improvements in aircraft, airports have not developed at an equivalent pace — in number or quality. Illustrations include the saturation of Kennedy, Newark, LaGuardia, Washington National and O'Hare Airports. Over the past decade, various proposals to build a fourth major airport in the New York City area have met with such strong community resistance that an acceptable site has not yet been found, with the result that aircraft activities at New York's airports have been constrained by rationing operations.

Because a disproportionate number of enplanements cluster around a relatively small number of major airports, growth of the total civil aviation system may be impeded by their failure to develop apace. Indeed, resistance to airports and associated landside development is perceptibly slowing our ability to use available new technology.

Airports interact in many complex ways with the communities where they are located, but the overall attitude of the community toward them is invariably negative. The reasons — noise, safety, atmospheric pollution, the attraction of unwanted ground traffic — are understandable, but the adverse reactions stimulated in those citizens who live near airports are translated into a virtual paralysis of those agencies charged with planning their expansion or improvement, or with building new ones. Unless airports can be designed that will fit more harmoniously into their surroundings, and an effective pro-air transportation constituency developed that will aid in solving such intransigent problems as siting, decision-makers will continue to be frustrated in efforts to keep airport development up with other parts of the system. Resolving the questions of airport feasibility and acceptability will provide industry with considerable guidance concerning the appropriate R&D effort they should place behind STOL, VTOL, or V/STOL systems. By the same token, government may more safely support demonstration projects, knowing that they are politically feasible and likely to trigger further interest by both producers and consumers. In short, the stakes here are of paramount importance; if major airports are effectively stopped through either political indecision, or a failure to understand which types of airport configurations are acceptable to the people directly affected by them, the economy in general and the aviation industry in particular will be the worse for it.

d. Financial Factors

- *Economic conditions in the aerospace and airline industries are inhibiting the translation of needs for new technology into effective market demand.*

A few key figures tell the story of the growing interdependence of the aerospace and air transport industries, and the dependence of both industries on favorable financial conditions for the flow of new technology between them. In 1969 purchasers other than the U.S. Government accounted for 63 percent of the backlog of orders for aircraft and related equipment and parts reported by major manufacturers in the aerospace industry. Meanwhile, procurements of aerospace products and services by the U.S. Government are forecast by the Office of Management and Budget to decrease from \$21.4 billion in 1968 to \$17.6 billion by 1971, the most protracted and sizable decline since 1948.

Thus, if it is to maintain current levels of employment and sales and, if it is to grow, the aerospace industry increasingly must look to the air transport industry as a market for new technology. Therefore, the economic well-being of the air transport industry, and its propensity and ability to acquire and implement new technology are now matters of import to the aerospace industry. Currently both are experiencing grave financial difficulties.

Since 1966, the airline industry has been unable to attain a satisfactory return on investment, in accordance with the standards for a fair and reasonable rate of return determined by the Civil Aeronautics Board. In 1969, U.S. scheduled air carriers reported an aggregate profit of only \$53 million on a gross investment of \$8.6 billion. Two out of every three scheduled carriers reported a net loss for the year. The Air Transport Association, the industry's trade association, estimates that the scheduled airlines will suffer an aggregate net loss for 1970.

A consequence of the industry's severe and deepening financial problems is the growing threat to its current reequipment program. Already, cancellations of orders previously placed with airframe and engine manufacturers have been announced. Tenuous financial arrangements for new aircraft are being jeopardized, with the possibility that the airlines will be unable to finance deliveries of aircraft for which orders are still firm.

Are the current financial problems transitory? Or, do these problems have long-run implications for the magnitude and viability of the air transport industry as a market for new technology? These are questions of major importance to the air transport and aerospace industries, and to the nation as a whole.

The aerospace industry, traditionally dependent for much of its sales on the needs of national defense, is notoriously cyclical. In 1940 it was a \$370 million industry; by 1944 it had grown to \$16 billion, but three years later, with the end of World War II, its sales were back down to \$1.2 billion. It

remained depressed until the buildup that resulted from the Korean War. A slowdown in the late 1950's, a marked increase in activity in the early 1960's, and a brief slackening were followed by the Vietnam War. Simultaneously with increased military aircraft procurement from 1965 to 1969, came the principal economic impact of the NASA lunar landing program and extensive airline purchases of new long- and medium-haul transports. The manufacturing capacity of both airframe and engine companies became greatly strained, extensive subcontracting with both domestic and foreign sources was resorted to, and industry employment increased substantially.

Recently, with the simultaneous declines in DOD aircraft procurement, the Apollo program and deliveries of commercial airliners, industry sales have decreased markedly. Furthermore, the manufacturers of civil aircraft and engines have some unique problems. Boeing, Lockheed and McDonnell Douglas have made investments in the Boeing 747, L-1011 and DC-10, respectively, well in excess of \$500 million each, as have United Aircraft and General Electric in the JT9D and CF6 engines. These outlays are a significant percentage of the total equity of some of these firms, and will not be recovered in full until 200-300 or more of each type of aircraft have been sold. Near the end of 1970, aircraft orders and options total 197, 178, and 237 respectively. Both the economic situation of the airlines and the existing overcapacity in passenger seats make it questionable that any of these programs will reach breakeven for some time to come, and, as mentioned earlier, raises questions concerning the ability of the airlines to finance the present orders. These programs have required such a commitment of resources by a substantial portion of the aerospace industry that they effectively preclude comparable investments in newer ones until present investments have been recovered.

The general aviation manufacturers face a somewhat different problem. To recover their development costs, although much lower than those of larger airframe manufacturers, an annual increase in sales of around 15% is needed. Sales of twin engine and turbine-powered aircraft are very closely correlated with corporate investment in new facilities and equipment, and those of smaller general aviation aircraft with personal disposable income. Thus, general aviation sales are highly dependent on the perceived state of the economy. The current depressed economic situation has not only arrested the growth of general aviation aircraft manufacturers but reversed it.

Neither larger nor smaller airframe companies currently are in a position to continue the more-or-less orderly progression of new model development that has characterized the industry for over a decade. This would not necessarily be critical except that, because of a similar slowdown in new military programs, there are few other projects in most companies to which unemployed

development engineers might be transferred. The industry faces a situation in which its vital development base might erode through disuse.

Traditionally the airline industry has not initiated detailed technical requirements for new commercial aircraft. The aircraft manufacturers have maintained a detailed familiarity with airline growth and operations, initiating proposals for new aircraft models when they perceived the time to be ripe. The airlines, on the other hand, have made skillful use of the highly competitive nature of the airframe and engine industries to get aircraft more closely suited to their particular requirements and to encourage price-cutting.

The years following the introduction of the Boeing 707, the Douglas DC-8 and their contemporaries were profitable ones for the airlines. These aircraft were much more productive than their predecessors, and stimulated by a buoyant economy, passenger volume greatly increased. By 1965 the combination of growing demand, air terminal congestion and high expectations for air cargo led the three major airframe companies to propose new high-capacity aircraft. Through 1966-67 the airlines ordered enough 747's, L-1011's and DC-10's to launch all three programs. Competitive pressures forced many air carriers into reluctantly ordering this new generation of equipment before they had adequately digested the 707/DC-8, 727, and DC-9/737.

The airbus market, which probably could support one manufacturer in comfort, is being shared between Lockheed and McDonnell Douglas, both of whom have large sums at risk and are far short of a breakeven level of sales. Furthermore, there is a considerable region of overlap in range and productivity between the airbuses and the Boeing 747 on many routes, and the availability of the former at appreciably lower prices (\$16 million versus \$23 million) has contributed to a slowdown of 747 sales. To summarize the situation, too many manufacturers are extensively committed to aircraft for which the airlines are not really ready, either financially or in terms of capacity. The suppliers and the users appear to have overstimulated each other, and the result is disruption and financial strain for both parties.²

An examination of the earnings experience of the airline industry during the thirty years since World War II adds further support to the view that periods of depressed earnings encountered by the industry are not due to cyclical downturns in the economy alone. During the economic downturn of 1949, the industry's rate of return was higher than it was in the two previous years. In the 1953-54 period of economic downturn, industry rates of return

2. See Section II, "R&D Management," Appendix B, for a discussion of the origin of the 747.

were among the highest levels of the postwar period. On the other hand, rates of return were depressed throughout the period from 1957 through 1963 — the period marking the end of the reequipment cycle for propeller aircraft and its beginning for jet aircraft. Undoubtedly there is a relationship between the state of the economy and the health of the industry, but, by and large, the cycling of airline earnings appears to be more directly related to industry's reequipment programs. The low rates of return experienced between 1947 and 1949 coincide with reequipment with pressurized propeller aircraft. Low rates of return experienced in the 1957-1963 period coincide with reequipment with the final pressurized propeller aircraft series and the introduction of turbo-prop and turbo-jet aircraft.

The incentive to overequip comes from competitive desires to be first in the marketplace with the most of the best aircraft, and to long-standing beliefs in the industry that capacity and frequency of service stimulate traffic. Statistics generally confirm that this is indeed the case. Not long ago this compelling line of reasoning was constrained, before it could do much damage, by the financial limitations of the industry. Air carrier equipment purchasing power was limited by credit standing. However, in successive waves of financing, the airlines have progressed from highly conservative bank credit sources, to insurance companies, and now to the leasing company. With each wave the industry has moved to less restrictive sources of capital and reached new levels of overcapacity.

Reequipment brings not only overcapacity, but also a set of secondary effects on airline operation, all of them costly and some difficult to foresee. These include induced needs for additional training of flight and ground personnel on new aircraft, additional or new ground facilities, special aircraft-related equipment of all kinds, and the customary "bugs" in new and highly complex aircraft. The net result is a sharp rise in operating costs and depressed earnings.

The coincidence of reequipment and depressed earnings bespeaks a chronic problem in the implementation of new technology, which is impairing both the economic health of the air transport industry and its standing as a market for aerospace products and services. The manifestations of this problem directly affect the aerospace industry in two ways. There is a natural incompatibility between the need of the aircraft manufacturer to achieve and maintain an economic rate of production on a large run of aircraft and the ability of the airlines to absorb new equipment, particularly now when equipment comes in increments of 350 seats and \$23 million. During progressive rounds of reequipment, the usual result has been not only overcapacity for the airlines, but also an increase in the capacity of the aircraft manufacturing industry. Secondly, the economic perturbations set up within the airline industry by the reequipment

cycle tend to make it a less stable and receptive market for the aerospace industry.

It can be argued, and correctly so, that these risks are inherent in the free enterprise system and so should be accepted by the participants. However, it also is true that the aerospace industry is a national asset, the largest manufacturing employer in the country, one of our principal technical resources, and of vital importance to national defense and the balance of payments. When the scale of resources required to develop a commercial aircraft or engine approaches those needed today, the results of miscalculation or unforeseeable events may be catastrophic. Disruptive instabilities in this industry and in its civil market must be alleviated or mitigated in the national interest.

e. Political Factors

1. The Present Regulatory Environment

- *The full potential for technological development is being constrained under the present regulatory system.*

Economic regulation of the transportation industry in the United States is the result of many years' experience in balancing the interests of private firms with the public interest. Although legal authority for transport regulation derives from the powers granted to Congress under the Constitution, the economic basis for regulation is rooted in the concept of natural monopoly.

Nowhere in the development of regulation is there specific instruction directing regulators to take the effects of technology into account. Such considerations are, however, implicit in a section of the Federal Aviation Act that directs the Civil Aeronautics Board to consider as being in the public interest, and in accordance with the public convenience and necessity, the encouragement and development of an air transportation system properly adapted to the future needs of commerce.

One of the problems, however, is that regulation under the Federal Aviation Act of 1958 requires a multiplicity of goals, some of which work to the detriment of technological innovation. As will be seen elsewhere,³ the relationship of regulator to the regulated industry is a paternal one in which entry to and exit from markets as well as price competition are closely controlled. The benefits conferred on the public by the regulatory process are not free of cost, however. Among the costs of this system are the partial loss of

3. See Section II of this report entitled, "Legislative and Regulatory Factors."

technical and managerial innovation that might be expected to result from a struggle for competitive advantage if transport firms were subject only to free market forces.

The requirement that the Board certificate for service applicants who are "fit, willing, and able to perform... transportation properly," provided that such proposed transportation "is required by the public convenience and necessity" places an enormous burden of proof on applicants for entry. It serves to assure that only the most conservative proposals receive serious consideration by the Board. Yet the history of technological innovation in the United States amply demonstrates the successful introduction of new developments in the market not because *market feasibility had been proved*, but because someone — either through foresight or luck — had a strong conviction that the idea would work. The concept that the marketplace should be the final judge of value is basic to our economic system, and has served to stimulate technical innovation. One might question whether such innovations as xerography, computers, or even the airplane itself would have been developed and sold if the final decision depended on an adjudicatory agency finding an applicant fit, willing and able, and in consonance with public convenience and necessity.

Another constraint imposed by economic regulation is system sluggishness — that is, the inordinately long time it takes for the regulatory system to rule that an air carrier will be permitted to respond to a need even when the technology to do so is available or can be made available. The CAB's Northeast Corridor STOL Investigation has been under way for two years; the Phase I report was issued this September. It is conservatively estimated that the Phase II hearings may take at least another two years. The CAB has concluded that such a system is needed, yet as long as five years probably will have passed before significant action is taken to meet this need. The following excerpt from the Phase I hearing states the problem and provides a good summary of many institutional constraints that are holding up STOL system development:

that a properly implemented metroflight system will be responsive to [the] major public need and... such a system is both technically and economically feasible... We recognize that the establishment of a comprehensive metroflight service... will not be free of difficulty, since its chief components — suitable aircraft, landing sites, and navigation technology — are not yet fully developed. All these elements, however, are clearly within the ambit of existing technology, and could be available within a relatively short space of time with the active commitment of the aircraft manufacturers and governmental bodies involved. A chief obstacle to progress toward metroflight has been the cycle of inaction that has affected the participants in its development: local authorities lack incentive to develop landing sites

in the absence of some assurance that appropriate VTOL/STOL aircraft will be available to use them, manufacturers are reluctant to begin active production to aircraft until they have sufficient orders, and carriers are unwilling to order equipment unless they can look forward to suitable landing sites. It is our hope that the Board's action in authorizing metroflight operations will break this impasse and serve as a catalyst for more active implementation of a viable VTOL/STOL system.⁴

The development of short-haul markets, air cargo traffic and resolution of the 12,500 pound weight restriction inhibiting development of commuter-market aircraft are examples of the deleterious effects of a regulatory lag.⁵

3. THE PRESENT CAPABILITY OF THE FEDERAL GOVERNMENT TO DEAL WITH THE PROBLEMS

The nature of the civil aviation problem is such that only the Federal Government is in a position to provide the leadership and direction necessary to break the institutional impasses and inadequacies that stand in the way of realizing the full potential of civil aviation R&D. It cannot solve all of the problems, but it can solve some and at least establish a viable framework for the ultimate resolution of others. What then are the constraints *within* the Federal Government that are inhibiting it from assuming a more forceful and effective leadership position on civil aviation research and development?

- *The ability of the Federal Government to formulate a comprehensive civil aviation R&D policy is severely limited given the nature of the problem and the institutional structure in which it must operate.*

Traditionally, transportation planning occurred on an *ad hoc* basis, or when considered comprehensively, by mode. Canals, roads, sea-going vessels, autos, and finally airplanes spurred a fragmented government response which ultimately produced the present modal administrations within the Department of Transportation. The current array of regulatory agencies (FMC, ICC, and CAB) was also produced by this long process. The evolution of committees, bureaus, and agencies to deal with each transportation mode was determined by

4. *Northeast Corridor VTOL Investigation*. Order 70-9-44, Sept. 8, 1970, pp.3-4.

5. These issues are further discussed in Section IV, "Subject Area Reports." See "Air Cargo," "General Aviation" and "STOL" subsections.

economic and political muscle wielded at various times by each mode, and by the government's special needs for expertise to contend with a particular modal requirement. The present question of allocating scarce resources among competing needs was not so important as it is today — the traditional approach resembled a requirements approach, and the problem of measuring "policy trade-offs" did not exist for yesterday's "logrollers."

Hence, today the Secretary of DOT may set and administer a unified policy only with the full cooperation of the modal administrators who are shielded from centralized control by an umbrella of conflicting laws and congressional committees. Moreover, the present financing arrangements tie FAA and FHWA into earmarked taxes and charges, permit long-range planning within *one* mode, but constrain it *among* modes. The Department of Transportation Act of 1966 limits the power of the Office of the Secretary in policy formulation and in fact states that transportation policy formulation, in the sense of approval and authority to implement, will remain a prerogative of Congress. Furthermore, the Office of the Secretary cannot formulate policy which would infringe on certain prerogatives of the Modal Administrators whose powers, for the most part, were transferred intact under DOT. Given these statutory limitations on the Office of Secretary of DOT, the formulation of a unified national transportation policy is a formidable task.

Lack of a national transportation policy constrains the formulation of civil aviation R&D policy, and ultimately the marshaling of Federal attention and action to address the problems. Clearly, with a portion of the resources required to place a man on the moon, provide health care and other welfare assistance to our citizens, or to construct an interstate highway system, most if not all, of the principal civil aviation needs could be met. The technical means are presently, or with sufficient R&D funding, can be made available. The civil aviation R&D effort, however, is competing with other significant national needs for our limited national resources. The issue is to what extent the nation is willing to rearrange its priorities for civil aviation needs, given its huge but nevertheless finite resources. The Federal Government has not been able to make up its mind on this issue and consequently, leadership and direction from Washington have been mixed and, for the most part, rather weak.

- *The full potential for technological development is constrained by fragmentation of the decision-making process at all levels of government, including the federal.*

The fragmented nature of the decision-making process is one of the most serious obstacles to attaining technology's full potential in aviation. Perhaps

nowhere in civil aviation is this more apparent than in the cluster of problems surrounding the nation's airport system. This complex and interrelated system requires extensive coordinated and informed decision-making; in addition to this, the airport planning and executing function must respond to mounting resistance over questions of siting, landside planning, access and finance. The fact that lead time from conception to completion is so long for airports – 10 years or more – further complicates the problem. Renewed emphasis on the urban environment has raised the stakes, but our ability to site new facilities has not grown.

Although the need for higher capacity airports has long been recognized, no one is conducting the research necessary to achieve technical solutions to the challenge. The airport, which serves as the key interface for all segments of the air transport system, has no one group or owner with the motivation or authority to perform R&D necessary to improve it. For example, airports are concerned with traffic development and operations; FAA jurisdiction and funding authority cease when air safety is no longer a factor; airlines have not been willing to extend their R&D concerns beyond their legitimate franchise areas; they have focused very little R&D attention on baggage handling, ticketing, etc., probably because they are not convinced that more people would fly if air travel delays and irritations were significantly reduced. As yet there is no recognizable market for improved airport access systems. These are the province of local governmental agencies and have low priority when compared to other pressing urban problems. This fragmentation of interests and authority through many local, state and national jurisdictions, combined with diverse interests of the private sector has resulted in chaos that obstructs the flow of technology into airport development.

The need for a better short-haul system is generally accepted. Airborne and ground delays in short-haul flights have frequently nullified the benefits of speedy jet equipment. Today the block-to-block time of a Boeing 727 flying from New York to Washington has not improved appreciably from what it was a decade ago using DC-6B's. Despite the recognized need for an improved short-haul system, the solution in a technically and economically viable STOL service is not operable today.

Given the historic unprofitability of short-haul routes, the lack of success in developing successful STOL is perhaps not surprising. It seems unlikely that aircraft development itself can solve the problem. Any new short-haul aircraft that must operate in the same environment of air traffic control, runways, and airports as long-haul aircraft will continue to be subject to most of the same delays experienced by the current generation of short-haul aircraft. What is needed is obviously a new short-haul system that can function compatibly with the long-haul system.

Institutional fragmentation has blocked any substantive achievements toward this goal. The development of an operational STOL system must involve the integrated efforts of a large number of private organizations and government agencies at the federal, state and local level. Two major components of a STOL system are the responsibility of the government – the air traffic control system and the airport, or STOL ports. The customers must look to the government (CAB) to delineate the circumstances under which they could operate STOL aircraft, while the manufacturer must look to the FAA for certification of the aircraft and engines. Finally, both the private sector and the Federal Government must look to state and local government for the approval and development of STOL ports. A STOL system thus has not been instituted because no single participant in the process needed to create the entire system has the ability to proceed independently of all the others.

- *“Research and Development” is defined too narrowly by the Federal Government and, therefore, tends to be isolated from the world of policy and economics.*

The spectacular growth of technology over the last twenty-five years frequently has been attended by unintentioned and unanticipated side effects which have occasioned economic costs for third parties, and dislocated societal and individual values. It is becoming increasingly clear that this will no longer be tolerated by the population. Technology and social values at least must be made aware of each other, if not reconciled to act as partners.

Creating a useful product (or for that matter even knowing what to ask for in civil aviation) requires close and frequent interaction between technologists and analysts who are assessing needs and the likelihood that particular technological solutions will in fact satisfy recognized needs within the confines of real world requirements – manufacturers will produce it, customers will buy it, and the public will accept it. Clearly, an iterative process between R&D in the physical sense and R&D in the “soft sciences” sense (to include the so-called “hard-headed businessman”) is needed. The traditional ways of viewing the R&D process have tended to obfuscate this obvious need.

The concept that hard and soft science considerations can be blended or traded-off somewhere near the top of the Federal Government hierarchy is no longer valid. Industry has long recognized the need to consider technological factors (new product development) together with business considerations (costs, market demand). A similar process generally does not exist within the Federal Government’s research centers where many of the soft science considerations could be addressed.

Questions of public acceptance, operating economics, and public needs are a fertile area for research. Clearly this type of research is intimately tied to

greater technological feasibility and vice versa. The two types of R&D should be coordinated at the working level. DOT provides an example of the problems the Federal Government faces when hard and soft sciences R&D travel to the top of government hierarchy on their own isolated paths.

Within the Office of the Secretary of Transportation, the Office of Assistant Secretary for Systems Development and Technology is charged with reviewing the R&D programs of DOT (mainly the Transportation System Center) and its modal administrations to insure that these efforts are coordinated and support national transportation goals. The office is handicapped in that (1) no comprehensive statement of transportation goals has been articulated, (2) until recently it has been underfunded and understaffed, and (3) even if it decided to "veto" any given R&D program, there is the possibility that Congress would restore it in reaction to pressure from modal interest groups. In effect, the office must use its persuasive powers based upon its own analyses.

In the area of program analysis, however, the office is limited by charter from having its own staff to perform benefit-cost analyses, demand studies, economic analyses, etc. These functions all reside in the Office of the Assistant Secretary for Policy and International Affairs. Thus the Office of Assistant Secretary for Systems Development and Technology must make its trade-off decisions between competing R&D programs without reference to the utility or impact of a given R&D program on a particular transport mode, or on the total transportation system. In short, the issues that the CARD Policy Study has had to address in arriving at its recommendations on the future course for civil aviation R&D cannot be addressed by the very office which presumably will have long-term responsibility for R&D policy implementation. Even at the peak of the government hierarchy, hard and soft R&D are being isolated from each other.

- *Coordination between DOT, FAA, and NASA presents problems, but not insurmountable ones, in the management of civil aviation R&D.*

There are numerous federal government agency participants in the management of civilian R&D. The major funding and performing organizations are the Department of Transportation (DOT), the Federal Aviation Agency (FAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD). R&D activities within DOT are carried on by the modal administrations (FAA, UMTA, etc.) and by the Office of Systems Development and Technology. NASA has four research centers (Ames, Langley, Flight Research, and Lewis) coordinated by the Office of Advanced Research and Technology (OART). A whole host of other departments and agencies are involved in the civil aviation R&D process in a variety of ways.

Formal communications among the federal government agencies are carried on by means of a large number and variety of interdepartmental coordinating committees; e.g., there are at least a dozen joint DOT/NASA committees. Considerable interaction among agencies takes place at lower organizational levels on an *ad hoc* and informal basis. Joint programs among agencies are frequently undertaken. In the past FAA and Langley Research Center have teamed up to simulate SST Air Traffic Control; HEW, Ames and FAA have met with the airlines to formulate a program for controlling aircraft air pollution in the vicinity of airports; and HEW and FAA are working together to make noise measurements at Los Angeles. These projects, for the most part, have developed informally as a result of common professional interests among individuals, or because of physical proximity.

HEW happened to hear about noise measurements that FAA was planning to make and offered their services; FAA happened to be present at Flight Research Center when studies of vortices from large aircraft were undertaken for the Air Force, and as a result, contracted for a similar study that they wanted done for the 747's.

Generally, these programs have originated in the lower echelons of the organization, not at the policy level, though the top levels of the organizations are kept well informed about joint programs. As might be expected these joint programs exist and are successful only when the agencies involved are able to clearly delineate each other's role and expertise, and remain cognizant of the perceived provinces of responsibility. When NASA restricts its ATC electronics capability to airborne equipment, FAA and NASA are able to cooperate on modest Air Traffic Control simulations. Cooperation diminishes rapidly when boundaries are violated, and one agency believes that it is relinquishing portions of its traditional role.

4. CLASSES OF OPTIONS AVAILABLE TO THE FEDERAL GOVERNMENT TO DEAL MORE EFFECTIVELY WITH THE CIVIL AVIATION R&D PROCESS

There are a number of options open to the Federal Government to improve the civil aviation R&D process. None of these are easy to implement, since all depend upon support from the Administration, Congress, and ultimately the public. On balance, however, we believe they are feasible within the context of current national values and priorities. In our opinion, the options discussed here are the most important ones stemming from our study. They are

classes of options; as such, they may relate to more than one of the major aviation problems discussed earlier. It should be noted that these are, of course, not the only options open to government; others are discussed in Sections II-IV of this report.

- *Civil aviation research and development should be redefined to include both hard and soft sciences and the necessary steps taken to organize and staff R&D activities to reflect this new approach.*

Specifically the Federal Government should augment the staff at its various research and development agencies and centers with experts in economics, finance, government, market research, etc. These personnel should be encouraged to interact on a day-to-day basis with technical staff so that a multidisciplinary attack can be launched on the problems of civil aviation. Thus, problems in both hard and soft sciences, and confusion about the direction research should take can be flagged early in the development process – not when it might be discovered, too late, that a solution was being offered for a nonexistent problem, that because of institutional constraints a new technology could not be applied, or that work was not under way on a problem possibly solvable by technology. The current organizational and conceptual isolation of hard and soft sciences R&D must cease if the nation is to avoid falling into many of the pitfalls of the past.

The benefits of such an approach are highlighted by the Department of Defense experience. Within the Office of the Secretary, the Defense Director of Research and Engineering (DDR&E) has a staff organization that is mission-oriented rather than geared to technical disciplines, e.g., antisubmarine warfare, formal Army Area Defense, etc., rather than electronics, missiles, aircraft, etc. In this office the technological disciplines have been blended, and operational personnel are included in each mission office. These latter personnel represent, in effect, the soft scientists. While the analogy between defense and transportation R&D is a weak one, the concept of combining technical with non-technical personnel signals a recognition by DOD of the benefits that can accrue from such an arrangement.

In the air transportation R&D field where products must be responsive to public needs and public tastes, soft science and hard science considerations should be explored simultaneously. To ignore or defer the latter has inevitably resulted, and will continue to result in, either the rejection of technologies that have been developed, or the failure to develop needed technologies.

- *The Federal Government should consider the commitment of substantial resources to Market Demonstration Programs. These provide a unique opportunity to overcome institutional inertia and test possible solutions to civil aviation problems (needs), without committing resources to a full-blown system which might not succeed.*

Demonstration programs afford an opportunity to suspend temporarily many of the institutional constraints which have inhibited the introduction of new technology into civil aviation. In some cases they may provide the *only* opening for the application of technology to meet our nation's legitimate air transport needs. So long as a program is experimental, opposition to it will usually fail to coalesce since the notion of giving something a "fair shake" seems to be endemic in our society. The Federal Government should take full advantage of this technique to prove that a particular technology or operating scheme will work.

Demonstrations should be employed in a far more extensive and imaginative manner than they have in the past. A few technical (proof-of-concept) and market demonstrations have been attempted in commercial aviation, but they have been the exception, not the rule. Subsidization of scheduled helicopter service in New York, Chicago and Los Angeles, and mail subsidy to local service carriers are two examples.

Demonstration projects are an important means of mustering resources to solve special problems when normal institutional processes inadvertently conspire to prevent the application of new technology. The introduction of radically new air transportation systems like STOL, for example, presents so many uncertainties that no single participant seems capable of taking the lead to produce an operating system. It is under precisely such circumstances that demonstration programs can be used to help prove or disprove plausible, but untested concepts.

In the initial decision of the Northeast Corridor STOL Investigation the CAB examiner noted that, not only was the "existence of a carrier fit, willing and able to initiate the service . . . obviously an essential ingredient," but also that "the prospect of the carrier's economic success is germane to the question whether it will undertake the operation. If it were shown that there is no chance of financial success, due to lack of patronage, or excessive costs, this would raise serious doubts regarding the institution of the service."⁶

6. Docket 19078, Served Feb. 2, 1970, mimeo pp. 22-23.

The groundwork is thus set for a demonstration program rather than the much riskier venture of establishing a full-blown STOL service. However, a STOL demonstration program, unless properly planned and implemented, could do more harm to the ultimate development of STOL than no demonstration at all. The operation of a Twin Otter or a Breguet in the current air traffic control system, using an existing instrument approach system, might only demonstrate that people would rather fly in a DC-9 which can do the same thing with greater passenger comfort.

The costs of demonstration programs, if properly implemented, can be far less than costs required to establish a full-blown system. A valid STOL demonstration program might cost several hundreds of millions of dollars or more for the aircraft and engine design competition and resulting demonstration equipment, the new ATC system for routes selected, a steep gradient approach system, and the STOL ports. The Federal Government would probably have to finance a major part of such a system. Commencing today the system would probably not be ready for demonstration until the mid-or-late 1970's.

Because of the institutional constraints on the development and introduction of a STOL system, a demonstration program of this magnitude is probably the only way the "iron ring" can be broken. Deciding whether or not the costs of such a demonstration would be justified in terms of future benefits to the nation is a separate matter. It seems clear to us, however, that if a STOL system is in the national interest, this is the direction the Federal Government must take, since it alone has the financial resources and authority to initiate such a project.

Demonstration programs of a more modest nature are also needed to provide a better understanding of how the market and the airline industry are likely to respond to various innovations in service, fares, and competition. For example, very little is known about what might happen if airline fares were increased significantly in the short-haul market. Would traffic drop off drastically, slightly, or not at all? Should airline fares be based on the cost of operating any given route segment rather than on the aggregate costs of all routes? With fares based on route segment costs, would aircraft be priced out of the short-haul market, thus firmly establishing boundaries on the "natural markets" of aircraft versus, say, high-speed trains?

A demonstration program could also address the question of allowing unrestrained competition on high density routes, thereby providing some test-tube answers to the relationship between regulation and the marketplace.

- *Continued and consistent federal funding of aeronautical research is necessary to assure the maintenance of a strong civil aviation technical base.*

Research may be divided into *basic research*, which is directed toward no concrete goal other than the advancement of knowledge, and *applied research*, which is undertaken with a specific application in mind for the knowledge sought.

In general, research is the domain of the scientist and the research engineer, while development normally requires more engineers and technicians than scientists. Typically, basic research requires less funding than applied research and development. It has been estimated⁷ that in fiscal year 1969 a total of \$160 million was spent by industry and the Federal Government on all kinds of basic research in the aeronautical field, as compared to \$771 million for applied research and \$1.87 billion for development. Other sources conflict in their particulars with these figures but confirm the fact that development is appreciably more expensive than research. A large airframe manufacturer may spend \$40-60 million per year on basic and applied research, while the development of a large airliner through certification may require \$500-700 million over a 3-to-5-year period.

Another major difference between research and development is the delay from the time a body of knowledge becomes available until it is put to practical use. Most products of aviation research do not achieve practical application until 10-15 years after research has been completed and perhaps one-third or more may never be used. By contrast, the development period required for a commercial airliner or a large turbofan engine from start of technical work to entry into commercial service is 3-5 years. Actually, research provides the technical tools that in due course will be incorporated into specific products. Thus, availability of a body of research knowledge for utilization is important to the continuity of the development process. If civil aviation research were reduced, the effects might not be felt for 10-15 years, but development engineers would eventually find themselves unable to effect substantial improvements in applied technology, because the basic scientific knowledge had not been generated.

The respective roles of government and industry in research and development in the aviation field are quite different. In the last 25 years the major source of Federal funds for aeronautical research and development has been the Department of Defense; that agency spent some \$25.5 billion for these purposes from 1945 to 1969. The sole objective of this effort, of course, was to provide superior military aircraft. Nevertheless, a significant portion of the funding was indirectly transferred to civil aviation through the experience and expertise that it provided the aerospace industry. The Boeing 707 airliner and virtually all of its successors and competitors are based on the aerodynamic

7. CARD internal working documents.

layout of the B-47 bomber (developed in the late '40's) and their turbofan engines evolved from the Pratt and Whitney J-57 of 1950. Military requirements and funding are responsible for the technical leadership that has supplied approximately 75% of the aircraft currently operated by the free world's airlines.

The second largest source of government funds for aeronautical research is the National Aeronautics and Space Agency. The interest of this agency in aeronautics dates back to the establishment of its predecessor, the NACA, in 1915. From 1945 to 1969, NASA (and NACA) spent approximately \$1.8 billion on aeronautical research.

In short, the Federal Government has sponsored a broad spectrum of aeronautical research very generously over the last 25 years, the bulk of which has been undertaken by the aerospace industry. However, when the government has funded development in the aviation field, it has been almost entirely for military aircraft. Virtually, the only exception has been the SST.

Industry has also funded a considerable portion of the aeronautical research and development performed since the end of World War II. In basic and applied research, approximately half of company expenditures (so-called independent research and development) are reimbursed as part of government production contracts. The other half of IR&D is subsidized to some extent because it constitutes part of company overhead and general and administrative expenses, which are negotiated annually with DOD. However, IR&D that contributes solely or primarily to commercial sales is not reimbursable by the government. Furthermore, the development of commercial products always has been undertaken by individual firms on a private venture basis. Where DOD sponsors aeronautical developments on a nonmarket basis, i.e., for national defense, the aerospace industry undertakes commercial developments only when it perceives market opportunities through the transfer of technology or technical knowledge gained on military contracts.

The foresight of the Federal Government in funding aeronautical research over the years has had a marked effect on the successful growth of civil aviation in the United States. This research involves high risk. The probability that a particular body of research will eventually result in a practical application is low; the realization of such an application can take many years. Often, the construction of expensive facilities to be utilized by various research teams is required. Many industries cannot afford the continual funding and effort necessary to build an effective research base; such research is usually a more legitimate province of government.

Unfortunately, it does not appear that, in the near future, the aircraft industry will be able to use its own funds to conduct a substantial portion of

the aeronautical research required by the United States. There are several reasons for this. The airlines are in financial difficulty and will probably not require a new round of equipment beyond current plans for some time. Procurement by the Defense Department will drop off, effecting a cut-back in the production base of the aircraft manufacturers; consequently, profits will be reduced. Additionally, the defense cuts will probably mean a reduction in IR&D funds for industry.

To further compound this problem, the Defense Department research budget will probably remain close to its present level, which means that in terms of purchasing power, it will actually be eroded by about 10% per year. As previously noted, civil aviation progress in the past depended significantly on fallout from large DOD investments in military aeronautical research. While it is still too early to evaluate the trend, the increasing complexity of military aircraft systems may indicate that fallout in the future to civil aviation from the national defense research program is less likely.

Moreover, government must again consider funding civil aviation research. If national policy advances the maintenance of our position as the world leader in civil aviation, including effective transportation systems, employment of people, balance of payments, etc., then we believe a continuing strong civil aviation research program is essential. To accomplish this, those agencies with statutory responsibility to advance civil aviation — the Department of Transportation and the National Aeronautics and Space Agency — must be prepared to take a more active role in funding civil aviation research.

- *Organizational and Policy Changes Should be Undertaken to Improve Intragovernmental Cooperation and Coordination in Civil Aviation Matters*

The major influence to date, in bringing about coordination and cooperation among the top levels of principal government agencies involved in civil aviation research and development, has been the Office of Management and Budget. By means of the budgeting and appropriations process, OMB has caused NASA and DOT to coordinate their FY72 budget requests line by line. Similarly, NASA and DOT are working to reconcile their independent interests in experimentation with satellite systems for civil aviation. The Office of Management and Budget, by requiring budget coordination between agencies involved in civil aviation R&D, is reducing the duplication of research activity. NASA's OART performs a similar function when it allocates funds to the research centers.

Some duplication of effort at the research level may be desirable. Duplication is not particularly costly, because research funding levels are low. In the early stages of a program, when there is a high degree of uncertainty about the

best way to proceed, competing approaches can be functional. In general, the funding organizations are tolerant of "common areas of interest," but this tolerance is almost entirely restricted to the research stage.

Certain practical and political obstacles hinder the achievement of an ideal solution to intragovernmental coordination within the existing structure. It is hard to conceive of Congressional committees relinquishing their funding authority and relationships with modal administrations, except in the very long term. Agencies will continue to compete for a top position. Effective communications and interactions will continue to result from *ad hoc* rather than formal mechanisms. Transportation systems needs will be hard to define in practical, meaningful terms, and translation of these needs into R&D programs will be imprecise.

Since most of the problems concern communication, cooperation, and control, perhaps the ideal solution can best be approached by incorporating all civil aviation R&D activities into one organization. This R&D organization could exist as a separate entity, as a part of DOT or NASA. Such reorganization would be in keeping with a recurring theme in our interviews; i.e., to revive the old NACA, a small, research-oriented agency, which was generally credited with outstanding people and research. The NACA structure was, of course, absorbed by NASA, and its laboratories and many of its people remain within NASA. Once again, many legislative and political obstacles stand in the way of a single aviation research organization, though it may be viable as a long-term solution. Furthermore, since the benefits of such centralization of civil aviation R&D are more theoretical than quantitatively demonstrable, there are no compelling reasons for reactivating NACA.

Improved intragovernmental coordination could be achieved through more modest options including strengthening the Office of Systems Development and Technology within DOT by providing it with the necessary staff and funding; providing an organizational mechanism within DOT to combine hard and soft technology inputs; and highlighting civil aviation within NASA by elevating aviation research to a plane equal to space, e.g., creating the Office of the Associate Administrator for Aeronautical R&D.⁸

8. These and other options relating to the problem of aeronautical R&D management within major government agencies are discussed in detail in Section II of this report.

- *Airports could enlarge their political constituencies by expanding the multiple-use approach to development.*

There is considerable evidence that the nation's largest urbanized regions will not readily endorse further airport development. Unless ways can be found to make airports "better neighbors," CTOL and STOL airport development appears blocked in and around the largest hubs. Research and development in the areas of engine noise suppression and pollution control may alleviate the problems, but it cannot do the whole job. New CTOL airports, which require vast acreages and accessibility from principal collection points within a region, will preempt land at the urban periphery. Community opposition to airport siting and expansion indicates that imaginative ways must be sought to translate airport-related land acquisitions into multiple-use projects.

There are several options which could align disparate interests behind airport development. Urban areas face many decisions relating to land-intensive functions that are carried out on or near the urban periphery. For instance, reservoirs, land reclamation projects, estuarine preservation, recreational areas, and public open space offer opportunity for acquiring large land areas for multiple uses. While not all land-use activities are compatible with airport development, a *flexible strategy* of *advance* acquisition of land, funded partly or wholly under the Airport and Airways Trust Fund could gain support for airports from sectors which are now hostile.

Conservationists and open space enthusiasts, for instance, are frustrated over the lack of funds available for state and local acquisition of park land, wild river basin areas, and other natural land areas that are accessible to our expanding urban populations. If land is not set aside for meritorious public purposes, incessant urban sprawl will preempt present open space for private use.

We believe a political constituency can be forged for airports by means of an airport land acquisition program — if two conditions are met. Funds must be diverted for acquisitions years ahead of actual need; consideration must be given to acquisition of *multiple* sites near urban areas. Groups interested in nonaviation, space-intensive activities could align with airport proponents to prevent scarce open spaces from being developed for low-density residential, commercial, or industrial uses. Political support here is predicated on the belief that environmentalists will endorse a constructive program which guarantees them at least some of their land needs now. Multiple-site acquisition in advance of airport needs would permit community leaders to avoid committing any particular site for airport development.

When airport development is required, the Federal Government could sell superfluous sites to state or local governmental bodies, perhaps at a price equal to the original acquisition cost, plus an accrued interest equivalent. This approach assures that funds would flow back into the Airways Trust and other Federal sources, and that the price would be attractive to other governmental units. The Federal Government would actually be involved in a landbanking operation that temporarily transfers airport funds to real estate holdings, at no cost to airways users. In the long term, the real economic cost would also be minimal, because the option does not sacrifice or utilize community resources; rather it provides for a transfer of ownership of existing resources, most of which have small alternative uses, e.g., swamps, wetlands, and agricultural land.

It is important to point out that the problem of interagency coordination can be substantially alleviated through the development of what are, in effect, interagency objectives and programs. A present constraint on coordination is the lack of mutual programs among agencies. Multiple-use projects could serve as the rallying point for further positive coordination.

A similar multiple-use approach would be feasible for acquisition of access corridors from the Central Business District (CBD), or other large collection points to the airport. The construction of "linear" cities, utilizing air rights and involving considerable urban renewal along a length of the access project, might be especially appealing. Conceivably, this approach could align ghetto residents behind the airport program. The multiple-use approach appears mandatory for inner-city STOL ports, since residents will not accept STOL unless they see advantages in an attractive multiple-use "package."

II. CIVIL AVIATION R&D MANAGEMENT

CIVIL AVIATION R&D MANAGEMENT

This section describes two different but interrelated frameworks in the civil aviation R&D management process in this country — the research framework, and the one for development efforts. The following elements are covered:

- The size of the civil aviation R&D establishment to illustrate how the system works;
- Those factors which prevent us from doing a “better” job;
- Options to remove or mitigate those factors which degrade our efforts; and
- Pros and cons of the alternatives presented.

In this report a “better” job is defined broadly — as advancing national goals, furthering our political aims, improving the quality of life, promoting economic growth (including balance of payments), etc., with a minimum expenditure of national resources.

The phrase “research” and “development” is popularly misused as an inseparable unit; no recognition is paid to the discrete nature of the two terms. Actually “research” and “development” imply different processes, funding levels, risks, probabilities of success, types of investigators, and means of implementation or communication of results.

Basic research is that work which is directed toward increased knowledge in science. The investigator is usually not concerned with specific applications; he desires a more complete understanding of the subject under study. Basic research is an area where risk is greatest, as measured by the probability that the product of any specific project will be utilized in a socially beneficial way; that is, most basic research projects “fail” since they are not directly and immediately incorporated into a useful device, but by their “failure” they contribute to knowledge. However, research projects may be cost-effective, since they generally involve relatively few funds and imply great leverage in the event of “success.” The tremendous payoffs from a few breakthroughs pay for a vast number of “failures.” This implies that society can afford to fund a large number of research projects, since historically we know that progress comes as a result of successful research.

We define *applied research* as that effort which is directed toward practical application of science. Often the need is determined in the context of a perceived

system, process or equipment goal – for example, a project to obtain a strong, lightweight, temperature-resistant material for use in the SST project. The investigator may be either a scientist or an engineer; his “raw material” is the output of past research or other applied research efforts.

Development is concerned with the systematic use of scientific knowledge for the production of useful materials, devices, systems, or processes. The development process is characterized by a clearly defined physical product. The costs of development are often large, but the risk that the product will fail to meet its performance goals is significantly lower than in either basic or applied research. The R&D dollar in the United States is applied in the following proportions: basic research, 7%; applied research, 25%; and development, 68%.

A number of abstract and complex issues are inherent in the definitions above. These will emerge as the structure of the R&D establishment in the United States is discussed.

The following overview provides an exploration into the general R&D process. No single project follows this outline completely, but all have some of the characteristics described.

The development process reduces the products of basic research and applied research efforts to practice. The raw materials for development are ideas, concepts or components (which we call technological building blocks); and the physical resources of materials, labor, and capital.

The decision to launch a development project can be and often is made on the basis of technical feasibility. Given sufficient resources, technology can fabricate operable hardware which can physically perform a given mission. This mode of operation is an analog of the military development process; in the arena of civil aviation, the approval procedure is or should be far more complex. The conditions of a free (or nearly free) market, the needs of potential users or buyers, and recently the attitudes of society as to the social usefulness or costs of a device (noise, pollution, sonic boom, etc.), must all be considered. In order to take into account all the relevant variables, the decision-maker must reconcile and balance a large number of factors which have their roots in both the “hard” and the “soft” sciences.

Research generally takes many years, and behaves badly in the presence of erratic funding. It responds only slowly to external demands for answers to problems. The time lags inherent in formulating a complete and accurate statement of a problem, finding an investigator, starting up a team and striving to find an answer, indicate that technological building blocks are not available upon demand in a practical timeframe.

The development process must operate mostly within the state of the art. It is too costly and takes too long to look for new technological building blocks during the development phase. Clearly, there will be technical problems during development, but one cannot afford to go ahead with development until the availability of required technology is reasonably assured.

Development is expensive. Probably 80% or more of the identifiable costs of a new aircraft or engine are incurred during prototypal development. The research process, as compared with development, is inexpensive. It involves a few people working over long periods of time with small amounts of material, looking for the answers to questions considered worthy of investigation.

1. SIZE AND NATURE OF RESEARCH AND DEVELOPMENT IN THE AIRCRAFT INDUSTRY

The civilian aviation industry has been tremendously successful in the years since World War II. Approximately 75% of the aircraft used by commercial air carriers all over the world were built in the United States. The broad acceptance of our products has caused the industry contribution to Gross National Product to grow from less than \$100 million in 1950 to about \$3.2 billion in 1967. In addition, the GNP contribution (not revenues) of U.S. certificated air carriers, who depend upon the aircraft industry, rose from about \$0.6 billion in 1950 to \$5.1 billion in 1967.¹

In addition to enhancing the nation's internal economy, the industry has played a major role in improving our balance of payments position. Exports of civil aviation products have soared from about \$90 million in 1950 to over \$2.2 billion in 1968.¹ In the face of this tremendous contribution to the well-being of the United States, the level of funds expended on civil aviation research and development has stagnated, at least in terms of constant dollars.

There have been many estimates made over the years of the magnitude of funding applied to civil aviation research and development in the United States. Complete and unambiguous data are not available for at least four reasons. First, private industry does not publish the scope of its effort in any consistent way. Second, it is difficult to sort out civil from military expenditures in industry, as we shall see later, when we discuss the role of government-supported Independent Research and Development and Bid and Proposal costs. Third, within the budget for directly funded Department of Defense research and development, it is difficult to say with certainty which projects have either direct or potential application to the sphere of civil aviation. Fourth, within both government and industry the criteria for classification of projects as to basic research, applied research, and development are unclear.

1. CARD, Internal Working Documents.

Nevertheless, a series of statistics were prepared recently for the CARD study² which tend to show the order of magnitude and relative direction over time of expenditures pertaining to aeronautical research. Figure 1 shows the total estimated dollars by category expended over the period 1955-1969 on aeronautical research and development. Figure 2 shows the same statistics reduced to an approximation of constant dollars.³ Figure 3 shows the total R&D funds, by source, in current dollars.

Whether the lack of increased funding for the civil aviation R&D industry is serious depends upon how one views the future. Some available data tend to indicate a possibility that the nation may be in danger of eroding its present premier position in the world market.

The statistics prepared for the CARD study demonstrate the time lag between the discovery of a fundamental piece of knowledge (a technological building block) and its application in an economically and socially useful device. The study examined the relationship between the generation dates of 418 discrete advances in aviation technology from 1945 to 1969 and the time periods during which they were first put into use.

These data are summarized in the following table:

TABLE II-1
GENERATION AND UTILIZATION OF SELECTED AVIATION TECHNICAL ADVANCES,
1945-1969

Generation Period	Total No. of Technical Advances	Percentage of Advances Applied to Civil Aviation During Periods							
		1946-1948	1951-1953	1955-1957	1958-1960	1961-1962	1964-1967	1967-1969	Not Yet Applied
1945-1950	106	1	3	12	39	5	7	-	33
1951-1955	96			1	29	18	17	1	34
1956-1960	100				1	6	29	6	58
1961-1965	84						20	10	70
1966-1969	32						3	6	91

2. *Ibid.*

3. The GNP deflator was used to adjust current to constant dollars. There are indications that this series may understate the effects of inflation upon the actual level of research and development.



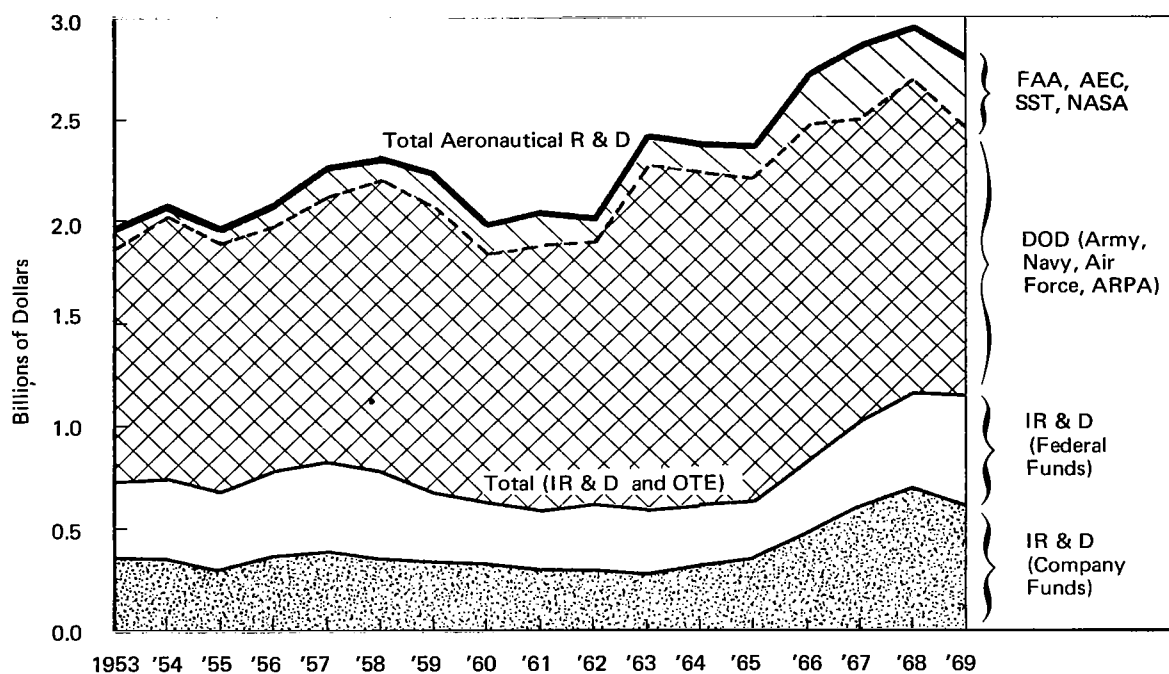
Source: CARD Internal Working Documents

FIGURE 1 ESTIMATED DOLLARS EXPENDED ON AERONAUTICAL RESEARCH AND DEVELOPMENT



Source: CARD Internal Working Documents

FIGURE 2 ESTIMATED CONSTANT DOLLARS EXPENDED ON AERONAUTICAL RESEARCH AND DEVELOPMENT (1968 = 100)



a. Derived from Table C-11 and Figure C-8 of BAAR Report

FIGURE 3 SOURCE OF AERONAUTICAL R & D FUNDS^a

This sample shows that most of the products of aviation research do not achieve practical application until 10-15 years after the research has been completed, and perhaps one-third or more of them may never be used, as such. However, the information gained adds to the storehouse of knowledge which often becomes material for a "successful" project. By contrast, the development period required for a commercial airliner or a large turbofan engine, from start of technical work to entry into commercial service, is 3-5 years. In a very real sense, research provides the technical tools that eventually will be incorporated into specific products. Thus the existence and availability of a body of research knowledge for utilization is important to the continuity of the development process. If civil aviation research were to be reduced, the effects would perhaps not be felt for 10-15 years, but eventually development engineers would find themselves unable to effect substantial improvements in applied technology because the basic scientific knowledge had not been generated.

A second bit of disquieting evidence was presented to the Congress by Dr. Bisplinghoff,⁴ showing that the number of aeronautical engineers graduating from our colleges and universities over the eleven year period 1955-56 to 1966-67 was roughly constant, but represented a generally declining percentage of all engineers graduating. (See Table II-2.)

TABLE II-2

DATA ON AERONAUTICAL ENGINEERS

	1955-56	1959-60	1961-62	1963-64	1965-66	1966-67
Number of aeronautical engineers	1,100	1,400	980	740	1,050	1,300
Number of graduates	18,000	23,000	22,000	27,000	30,000	41,000
Aeronautical engineers, as a percentage of total	6.3	6.1	4.5	2.7	3.5	3.2

4. *Issues and Directions for Aeronautical Research and Development*, House Report 91-932, 91st Congress, Second Session, p. 91.

The significance of the data presented in Table II-2 depends on whether or not the number of aeronautical engineers was adequate or excessive to the needs of the mid-50's, and whether the current number is sufficient to do the job at hand. Regardless of how one answers those questions, the data do show that young people who choose engineering as their profession today believe that the future in aeronautics is a less promising field than did those who went before them.

An additional matter for concern is recent evidence that federal funding for basic research in universities has not kept pace with combined increases in general enrollment and higher costs. Two surveys conducted by the National Science Foundation, in the spring of 1969 and the spring of 1970, reveal that federal funds for scientific research performed in private institutions have declined 3% in the last two years; at a time when the cost of conducting research is increasing at a rate estimated by DOD at 10% annually. Much useful aeronautical research has been performed by university groups, and reductions in federal support cannot help but have deleterious long-term effects on the national capability in this field.

2. INDUSTRY

There are three sources of funds which contribute, either directly or indirectly to the performance of civil aviation research and development in the private sector; direct government contracts from DOD, NASA or DOT, indirect government funds in support of Independent Research and Development (IR&D) or Bid and Proposal expense (B&P) and, finally, company funded projects.⁵ A sample of the major participants in the industry are listed in Table II-3.

Many of the companies listed in Table II-3 are involved in both defense or space as well as civil aviation endeavors. Therefore, the precise origin and funding of civil aviation products is more or less unclear. In the case of the SST, Boeing and GE are being funded directly by government, through FAA, for a significant share of the costs of developing an aircraft exclusively for civil use, though military applications may arise if the project succeeds. At the other end of the spectrum is the development of aircraft made by companies like Piper which have little government work; their developments are supported virtually 100% by company funds. In between is a whole spectrum of indirect cost sharing or technical transfusion between government and commercial activities.⁶

5. See Appendix A for a discussion of the contribution of selected foreign governments to their respective civil aviation industries.

6. Appendix B describes the circumstances surrounding the development of the Boeing 747 and its engine, the Pratt & Whitney JT9D. The process discussed is not "typical"; since few projects of such scope are undertaken, the facts of each are unique. The case does illustrate though, the complex intertwining of civil markets and military programs which has existed in the jet era of civil air transportation.

TABLE II-3

PRINCIPAL U.S. SUPPLIERS TO CIVIL AVIATION

Airframe Manufacturers

Beech
Boeing Seattle
Boeing Vertol
Cessna
Grumman
Lockheed
McDonnell Douglas
North American Rockwell
Piper
United Aircraft Sikorsky

Engine Manufacturers

Avco Lycoming
Garrett Airesearch
General Electric
Teledyne Continental
United Aircraft Pratt & Whitney

Avionics Manufacturers

Bendix
Collins Radio
General Motors
Honeywell
Narco
Northrop Nortronics
RCA
Westinghouse

Component and Subsystem Suppliers

Abex
Avco Nashville
Bell Helicopter
Bendix
Curtiss Wright
Fairchild Hiller
General Dynamics Convair
Menasco
Northrop Norair
Rohr
Teledyne Ryan

TRW
United Aircraft Hamilton Standard
United Aircraft Norden

It would probably be helpful to describe in more detail how the research funding process actually works. Let us assume that we are talking about a large airframe manufacturer which participates in both military and commercial sectors. Let us further assume that the manufacturer feels there may be a market for a new military transport, but that some of the problems to be solved in preparing a proposal for the military would have potential value to the company's civilian efforts. The company could initiate an IR&D project to investigate some critical parameters in detail. There are some hurdles to overcome. The program must be approved, in advance, by the government; and the results, if any, must have their principal applications in fields of interest to the national defense. Assuming the project can satisfy these requirements, the costs incurred can be charged to overhead, up to a predefined and negotiated dollar limit, which is allocated over all contracts, both commercial and government, held by the company. Similarly, if a technical project is undertaken to assist the company in the preparation of a bid or a proposal to the government, the costs are eligible for inclusion in the overhead pool. Historically, about 50% of IR&D and 60% of B&P costs have been reimbursed by the government. The overall levels of the two expenses have been determined by the level of government sales, being normally in the range of 1.5-2.0% of such sales, although recently Congress has moved to place an upper limit, expressed in dollars, on the aggregate IR&D and B&P that the government will accept from industry.

Government-funded research and development that is directly contracted for by the various agencies normally originates with government, or through the continuous technical dialogue between government and industry. On the other hand, IR&D projects normally originate in industry. Through the channels just described, government is a major sponsor of the research and applied research done by industry, but rarely (the SST) does government fund development of primarily commercial aviation products. Virtually all development projects which have led to production of commercial products have been conceived by industry based on its understanding of the needs, constraints and economics of the markets it serves.

3. THE FEDERAL ORGANIZATION

Organizations within the Federal Government that have major direct or indirect roles in the performance of civil aviation R&D are DOD, DOT, FAA and NASA. Other agencies have only relatively minor influence. Figure 4 is a partial organization chart of the Executive branch which shows the various departments, agencies and commissions which affect the civil aviation research and development process. Capsule summaries of the roles played by each of the agencies are shown in Table II-4, and a sample of the types of programs each has currently under way are listed in Appendix C.

FIGURE 4

PARTIAL ORGANIZATION OF PRINCIPAL DEPARTMENTS AND AGENCIES INVOLVED IN CIVIL AVIATION RESEARCH & DEVELOPMENT

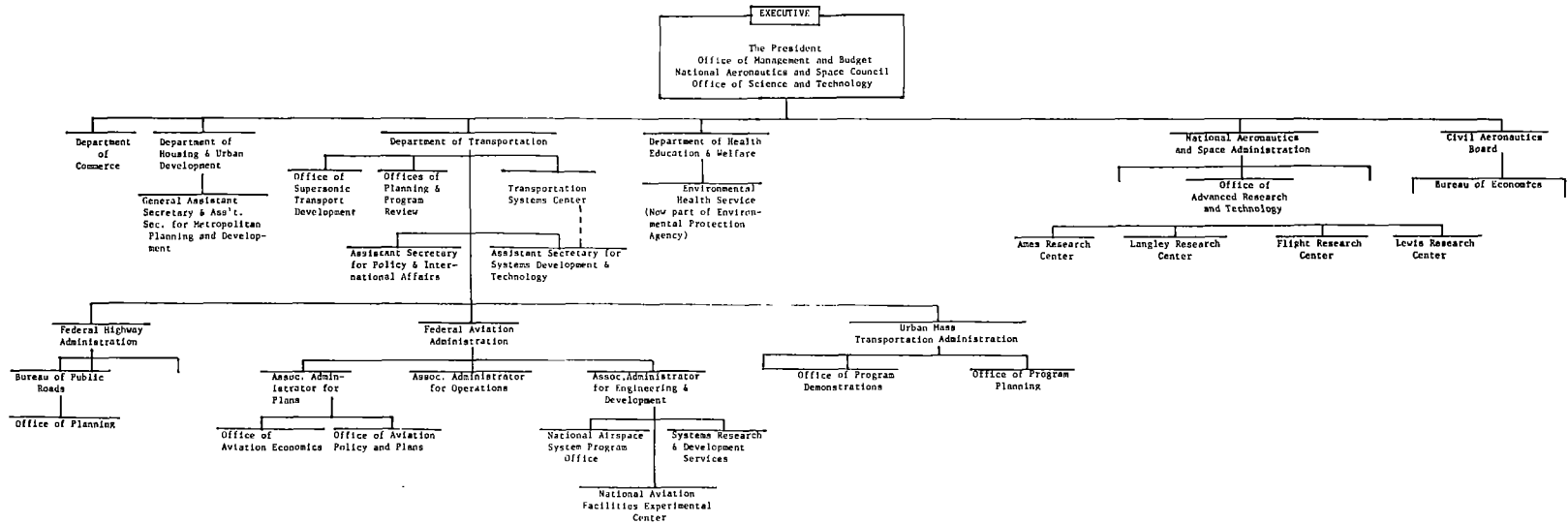


TABLE II-4

CAPSULE SUMMARIES OF ROLES OF AGENCIES IN CIVIL AVIATION RESEARCH AND DEVELOPMENT PROCESS

AGENCY	CIVIL AVIATION ROLE
Executive	
Office of Management and Budget	- Assist in developing efficient coordinating mechanisms and expands interagency cooperation.
National Aeronautics and Space Council	- Fix the responsibilities of agencies engaged in aeronautical activities and develop a comprehensive program.
Office of Science and Technology	- Develop policies and evaluate and coordinate programs to assure effective use of technology.
Department of Transportation	- Administers agencies who are concerned with the Nation's transportation system
Office of the Secretary	- Overall planning, direction, and control of departmental affairs.
Office of Program Planning and Review	- Reviews modal administration programs; asks for economic studies in support of programs.
Transportation Systems Center	- Perform advanced systems and technological research and development in all transportation disciplines.
Office of Supersonic Transport Development	- Provides direction for design and development of a commercial supersonic transport aircraft.
Assistant Secretary for Systems Development and Technology	- Responsible for scientific and technological research and development and for technological input into policy.
Assistant Secretary for Policy and International Affairs	- Responsible for transportation policies, objectives, and systems; and a comprehensive transportation data and information system.
Federal Highway Administration:	- Concerned with total operation and environment of highway system, including airport access.
Bureau of Public Roads	- Administers Federal-Aid Highway Program of financial assistance to states.
Office of Planning	- Coordinates and plans future programs, including airport access.
Federal Aviation Administration	- Regulating, operating, and developing civil aviation systems.
Associate Administrator for Plans	- Responsible for future direction and plans of Administration.
Office of Aviation Economics	- Prepares economic and aviation demand forecasts, performs special studies for Administration.
Office of Aviation Policy and Plans	- Assists in forming policy and plans, conducts special studies.
Associate Administrator for Operations	- Responsible for operation of airport and airway systems.
Associate Administrator for Engineering & Development	- Overall planning and control of Administration R&D,
National Airspace System Program Office (NASPO)	- Manages specific programs to aid development and implementation.
National Aviation Facilities Experimental Center (NAFEC)	- Responsible for test and evaluation of new systems.
Systems Research and Development Service	- Develops or directs development of new systems and equipments.
Urban Mass Transportation Administration	- Assist in development of improved mass transportation facilities.
Office of Program Demonstrations	- Coordinates and directs mass transportation demonstration programs.
Office of Program Planning	- Responsible for future planning of Administration.
Department of Commerce	- Performs economic studies (role greatly reduced with formation of DOT).

TABLE II-4 (Continued)

AGENCY	CIVIL AVIATION ROLE
Department of Health, Education and Welfare	- Administers agencies who promote the general welfare in the fields of health, education and social security.
Environmental Health Services	- Coordinates programs which relate to the environmental health of the general public.
Department of Housing and Urban Development	- Administer and coordinate principal Federal programs which provide for housing and communities development.
General Assistant Secretary for Metropolitan Planning and Development	- Directs programs and activities in areas of metropolitan and community planning and development.
Civil Aeronautics Board	- Vested with economic regulatory powers over civil aviation.
Bureau of Economics	- Performs studies relating to the economics and operation of civil air transportation systems.
National Aeronautics and Space Administration	- Develop, construct, test and operate aeronautical and space vehicles.
Office of Advanced Research and Technology	- Coordinates agency's total advanced R&D program to avoid duplication.
Ames Research Center	- Spacephysics, simulation, gas dynamics, aeronautical and space vehicle research.
Langley Research Center	- Aeronautical space structures and materials, subsonic and supersonic flight.
Flight Research Center	- Research in extremely high performance aircraft.
Lewis Research Center	- Power plants and propulsion.

a. Department of Defense

The Department of Defense is, of course, the largest single funding source for research and development within the Government. Under its legislative authority, it can and does justify investigation of every field of technology which might remotely bear upon national defense. Over the years, DOD has spent vast amounts on aviation technology, and a great deal of what was learned from that effort has become the backbone of today's civil technology. Each of the commercial jet transports in current use had its origins in DOD interests, either as direct derivatives of military products, or as developments based upon designs not chosen for military procurement. Similarly, the solid-state navigation, radar, beacon and communications equipments in use in transport and general aviation aircraft owe a great legacy to military avionics projects of the past.

Table II-5 is an estimate of the amount of DOD RDT&E which has potential civil application. Unfortunately, we do not have a time series of the information contained in Table II-5, so we can only speculate whether the contribution of military fallout to civil aviation has been increasing or decreasing. (The data contained in Table II-5 are expanded by technical area in Table II-6.) It is logical to expect that if the military budget declines, as it is expected to do, over the next several years, and as civil and military aviation requirements continue to diverge, the civil applicable portions of the budget will be seriously eroded. If DOD fallout does decline, as one might expect, either NASA and/or DOT will have to pick up the slack, or the nation will have to be prepared for a decrease in vitality of our civil aviation effort. It is important to add that the dollars lost in the DOD programs do not necessarily have to be replaced on a one-for-one basis, since presumably, funds spent directly for the purposes of civil aviation can arrive at a given objective for less money than if we rely on fallout alone. In making this assertion, we assume that there are certain portions of each DOD-sponsored project which pertain only to military needs, and that the communications process between DOD and the civil agencies is not perfect.

TABLE II-5
DOD AERONAUTICAL RESEARCH AND DEVELOPMENT
Fiscal Year 1971
(millions of dollars)

DOD RDT&E Development Categories	Specifically Military	Of Mutual Interest to Civil and Military	Total	% Mutual Interest
Exploratory	64.7	81.0	145.7	55.6
Advanced	101.9	84.7	186.6	45.4
Engineering	837.0	11.8	848.8	1.4
Operational Systems	420.3	17.6	437.9	4.0
Total	1423.9	195.1	1619.0	12.1

Source: See Appendix C.

TABLE II-6

FISCAL YEAR 1971 – DOD AERONAUTICAL RESEARCH AND DEVELOPMENT
Estimated from President's Budget
(in millions dollars and percent of total)

DOD RDT&E Development Categories		Technical Areas												Total	
		Aerodynamics and Design		Propulsion		Stability & Control		Structure		Avionics		Operational Support and System			
		A	B	A	B	A	B	A*	B	A	B	A	B		
Exploratory	\$M	0.9	11.5	3.7	24.4	0	8.6	0.3	5.6	10.4	21.1	49.4	9.8	145.7*	(162.2)**
	%	0	0.72	0.23	1.53	0	0.53	0	0.35	0.65	1.3	3.06	0.60	8.9	
Advanced	\$M	10.0	17.2	0	22.0	7.9	13.7	0	9.6	29.6	18.2	54.4	4.0	186.6	
	%	0.62	1.06	0	1.36	0.49	0.84	0	0.59	1.82	1.13	3.35	0.25	11.51	
Engineering	\$M	0	2.2	0	0.2	0	0	0	0	43.0	5.8	794.0	3.6	848.8	
	%	0	0.14	0	0	0	0	0	0	2.66	0.36	49.07	0.22	52.45	
Operational Systems	\$M	5.0	0	3.5	0	0	0	0	0	0	0	411.8	17.6	437.9	
	%	0.31	0	0.22	0	0	0	0	0	0	0	25.41	1.10	27.05	
Total	\$M	15.9	30.9	7.2	46.6	7.9	22.3	0.3	15.2	83.0	45.1	1309.6	35.0	1619.0**	
	%	0.93	1.92	0.46	2.89	0.49	1.37	0	0.94	5.14	2.79	80.90	2.17	100.0	

Notes: (*) Column A – Projects that are aimed at a specific military problem which in the foreseeable future appear to have little or no civilian application.

Column B – Projects similar in nature to work being done by NASA or FAA and of mutual technical interest. Normally coordinated at OSD-NASA Headquarters level and at military service/NASA working levels.

(**) The differences are due to approximately \$16.5M of Aerospace Avionics program element being devoted to Space (\$8.8M) and Missiles (\$7.7M).

Source: Statement for the Record by The Honorable John S. Foster, Jr., Director of Defense Research and Engineering, Department of Defense Before the Senate Committee on Aeronautical and Space Sciences, 18 March 1970.

DOD plays another very important role in the funding of aviation research and development by indirectly supporting work in private industry. Allowances are made on cost type contract overhead both for Independent Research and Development (IR&D) and Bid and Proposal (B&P) expenses. The costs of these activities to the government are a part of the procurement budget, so are not directly credited to research and development expenditures in most analyses. It is estimated that in FY71 the total IR&D and B&P funded by DOD will amount to some \$625 million.

b. The Department of Transportation

The Department of Transportation (DOT) was established pursuant to the Department of Transportation Act of 1966 (80 Stat. 931, 49 U.S.C. 1951). The Act is the response of Congress to a proposal made by President Johnson for the establishment of a cabinet-level Department of Transportation which would consolidate and rationalize the activities of government in the field of transportation. Although the Act is discussed in more detail in Section III "Legislative and Regulatory Factors," and in Appendix D, some portions are indispensable to understanding the current state of civil aviation R&D policy.

Prior to passage of the Act, civil aviation R&D activities were carried out independently by NASA and the FAA. Neither agency expended significant portions of their budgets on R&D directed at the improvement of our civil aviation system as part of a balanced national transportation system. NASA's involvement has primarily been directed at applied research, with some small amounts spent on basic research. FAA, on the other hand, is primarily an operational agency, although it does perform R&D especially in the development and application area.

President Johnson's message to Congress emphasized the need for the proposed agency to take the lead in increasing activities in the civil aviation R&D field. The message noted that less than 1% of the Federal R&D budget was being spent for civil transportation. Congress responded by stating in Section 4(a) of the Act "The Secretary . . . shall . . . promote and undertake research and development relating to transportation, including noise abatement, with particular attention to aircraft noise . . ."

Although Section 4(a) appears to be a mandate to take real action and to lead the Federal effort in R&D on behalf of civil aviation, other sections of the Act tend to prevent the Secretary from doing an effective job. For example, Section 4(b)(1) states "In carrying out his duties and responsibilities under this Act, the Secretary shall be governed by all applicable statutes . . ." Section 4(b)(2) reads "Nothing in this Act shall be construed to authorize, without

appropriate action by Congress, the adoption, revision, or implementation of (A) any transportation policy, or (B) any investment standards or criteria . . .” The Act, established three relatively autonomous modal administrations (FAA, FHWA and FRA) within the Department, and in numerous sections transferred to the Administrators, not the Secretary, the various functions which they had carried out while independent (as well as some new ones). Finally, in Section 9(e)(3) we find “The Administrators established by Section 3(e) of this Act may not delegate any of the statutory duties and responsibilities specifically assigned to them by this Act outside of their respective administrations.”

Although the Act did not spell out the duties of the four Assistant Secretaries which it authorized, it was expected that one would be concerned with R&D. Today there is an Assistant Secretary for Systems Development and Technology, but the office has been and is operating under some severe limitations. First, staffing has been a problem. Because of the change in Administration and the appointment of one incumbent to another position, there have been three occupants of the office in the less than four years since it was established (and a large part of that time, it was vacant). Only recently the office has reached 75 employees, of whom 49 are professionals, and attained a budget of \$14 million for R&D. Second, there is no stated transportation policy to guide the office in making trade-offs among competing projects, or in making budget decisions. The situation improved with the passage of the Airport and Airway Development Act of 1970 (84 Stat. 219) which directs the Secretary of Transportation to formulate a national transportation policy. Section 3(a) states:

Within one year after the date of enactment of this title, the Secretary of Transportation shall formulate and recommend to the Congress for approval a national transportation policy. In the formulation of such policy, the Secretary shall take into consideration among other things — (1) the coordinated development and improvement of all modes of transportation, together with the priority which shall be assigned to the development and improvement of each mode of transportation; and (2) the coordination of recommendations made under this title relating to airport and airway development with all other recommendations to the Congress for the development and improvement of our national transportation system.

Third, the existence of several different Congressional oversight committees is a potential destabilizing factor from the standpoint of achieving unified departmental policy. In effect, the Office of Systems Development and Technology must use its persuasive powers based upon whatever analysis it is able to make. Program analysis is limited, since the charter of the Assistant Secretary of Systems Development and Technology is proscribed from conducting benefit-cost

analyses, demand studies or economic analyses. These are the province of the Assistant Secretary for Policy and International Affairs. Thus, as a practical matter, one office is limited to "hard" R&D, while the other is charged with the "soft" science studies. (Table II-7 shows the FY71 program funding levels for R&D within DOT.)

The only other part of DOT which has a significant stake in civil aviation R&D is the FAA. Under the terms of the Department of Transportation Act, the FAA is one of the three modal agencies which were transferred to DOT. But, as pointed out earlier, the duties and responsibilities of the FAA were transferred to the Secretary and immediately delegated back to the Administrator. The powers and duties of the Administrator were spelled out in Section 103 of the Federal Aviation Act of 1958 (72 Stat. 731); "(b) The promotion, encouragement and development of civil aeronautics; (d) The consolidation of research and development with respect to our navigation facilities, as well as the installation and operation thereof," and amplified in the various parts of Section 312. Traditionally, the primary interests of FAA have been operational; the Administration has been concerned with air traffic control (ATC), certification of aircraft and airmen and the technology of runways. FAA's limited interests in R&D have been concentrated on ATC, and its budget has been modest and highly variable. (See Table II-7 and Table II-8.) (Throughout this discussion we will overlook the SST, which is assigned to FAA.) As noted in the Brooks Committee Report,⁷ the FAA has been unable to establish a sustained outstanding level of competence in the fields of systems engineering and development over the years. Such a systems group in existence from 1962-1965 was disbanded in 1965. FAA has tended to rely upon contractors both for analysis and equipment; this is one reason why the implementation of new systems has lagged behind demands placed upon the ATC structure. However, the FAA recognizes the problem and is currently in the process of staffing a Systems and Management Office (SEMO) within the Office of the Associate Administrator for Engineering and Development. The new office will maintain cognizance of the R&D programs of Systems Research and Development.

c. NASA and NASC

The Aeronautics and Space Act of 1958 (72 Stat. 426, 42 U.S.C. 2451 *et seq*) as amended, established the National Aeronautics and Space Administration (NASA) and the National Aeronautics and Space Council (NASC). Sections 102 and 203 of the Act set forth the basic functions of NASA. Some pertinent references are discussed in Appendix D.

7. *Problems Confronting the FAA in the Development of an Air Traffic Control System for the 1970's*, 29th Report by The Committee on Government Operations, July 16, 1970.

TABLE II-7

SUMMARY OF FY71 R&D PROGRAM FUNDING BUDGET SUBMISSION
(millions of dollars)

	Total R&D Budget	Technological R&D	Other Research
DOT	181.6*	155.2	26.4
Office of Secretary	22.0	14.2	7.8
Coast Guard	24.0	24.0	—
FAA	47.5	47.5	—
Federal Highway Administration	16.2	13.9	2.3
National Highway Safety Board	28.7	24.3	4.4
Federal Railroad Administration	23.2	20.2	3.0
UMTA	20.0	11.1	8.9

*Does not include the SST or HPR funds.

Source: U.S. DOT, Transportation Research and Development
Fiscal Year 1970 Program Analysis (May 8, 1970).

TABLE II-8

SUMMARY OF SELECTED FAA APPROPRIATIONS
(millions of dollars)

Year	Research & Development	Facilities & Equipment
1955	2	5
1956	1	16
1957	2	75
1958	15	125
1959	32	159
1960	49	118
1961	65	165
1962	60	120
1963	35	125
1964	40	100
1965	40	50
1966	38	50
1967	28	28
1968	27	54
1969	27	120
1970	46	224

Source: Years 1963-1970, Brooks Subcommittee Hearings, U.S. House of Representatives, 16 July 1970, pages 26-27.
Years 1955-1962, U.S. Federal Budget figures.

Between 1945 and 1969, NASA and its predecessor, NACA spent approximately \$1.8 billion on aeronautical research. Although this represents a large amount of money in total, in recent years, less than 2% of the NASA budget has been spent on aviation and aviation-related activities. Furthermore (at the time of this writing), aviation research occupies a position within the organizational structure below the level of an Associate Administrator. However, there are signs that with the winding down of the space program, NASA is once again reviving aviation as a major mission.

NASA, through its four research centers, has concentrated on basic and applied research. The research centers are largely responsible for the direction of their own work, prepare their own program budgets and present them to the Office of Advanced Research and Technology (OART) which coordinates the various pieces and presents them to OMB and to Congress. New programs originate at the working level either as a result of needs and demands of the transportation system, which tend to *pull* the state of the art upward, or as a result of opportunities and promise of new technical discoveries, which tend to *push* progress. For example, the recent flurry of work on vortex profiles of large jets resulted largely from pull — the need to understand the effects of 747's and C-5A's on terminal area separation standards. The work being done on externally-blown flaps, on the other hand, is representative of the push kind of project, where technologists evaluate the state of knowledge and nature and decide that an *interesting field for investigation exists*. Whether new programs originate due to push or pull depends upon the degree to which operational needs are transmitted to the research and development establishment. In the absence of clearly communicated needs, one might expect most projects to be of the push variety.

From the foregoing, it is clear that allocation of resources among programs is a difficult management decision, which involves choosing among technical options and deciding which projects will best meet overall transportation needs. In order to make effective allocation decisions, it is necessary to have a policy framework which includes a clear and continually updated statement of transportation system needs; this statement should be arrived at only after thorough study of both technical and nontechnical (market demand, societal and environmental requirements, etc.) factors.

It is not reasonable to expect that every research project have a specific operational requirement as a prerequisite to justify expenditure of funds. Such a constraint would lead to eventual technological bankruptcy — where needs are defined in terms of available technology and technology is only made available to satisfy needs.

In fact, NASA recognizes the need to be ahead of operational requirements and tries to provide useful research information relating to national transportation

goals as they are transmitted to NASA, or as NASA perceives them internally. Further, NASA has assumed the responsibility for undertaking proof-of-concept type projects in instances where it believes private industry cannot proceed without such information.

Historically, NASA has thought of itself as a data bank for the collection and wide dissemination of technical information which others can then apply. To implement this concept, the various research centers have been organized functionally. There are indications that this disciplinary organization is changing. Recently Langley Research Center has reorganized itself along mission lines. The Director of Aeronautics now has Directorates of Low-Speed Aircraft, High-Speed Aircraft, Hypersonic and Advanced Transport reporting to him.

The Aeronautics and Space Act of 1958 also created the National Aeronautics and Space Council. Section 201 provided that the NASC was to advise and assist the President with the formulation of policies, plans and programs, and to fix the responsibilities of the various Federal agencies for activities in the areas of aeronautics and space. The Council is composed of the Vice President, the Secretary of State, the NASA Administrator, the Chairman of the AEC and the Secretary of Transportation (added this year). The Hechler Committee has noted that NASC, like NASA, has been primarily concerned with space and has given little attention to developing integrated policies, plans and programs in the fields of aeronautics and aviation. Since the Council is purely an advisory body, it is questionable how much influence it can have in directing national resources toward or away from any particular endeavor. William Anders, Executive Director of NASC, an ex-astronaut, has at least recognized the need to shift some of the Council's attention toward aviation.

We have dealt with the internal organization of each of the three major Federal R&D performers, but have not touched upon the structure for coordination of efforts among the various organizations. The Congress, in establishing each of the several agencies, has been conscientious in directing that coordination and liaison shall take place. Examples can be found in the Space Act of 1958, directing NASA to interact with DOD; in Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966; Section 134 of the Highway Act of 1962; and the Airway and Airport Development Act of 1970. In addition, the executive branch, through BOB Directive A95 has directed coordination of budgets to prevent duplication of effort. In carrying out these various mandates, the departments and agencies have established a vast number of *ad hoc* committees. It was reported in hearings before the Senate, that in 1966, NASA alone was a member of some 27 interagency aeronautics committees.⁸ Yet from our interviews within the government aviation research establishment, most of the

8. *Hearings before the Committee on Aeronautical and Space Sciences*, 90th Congress, First Session, January 25, 26 and February 27, 1967.

meaningful instances of coordination, liaison and joint participation seemed to stem from the initiative of people at the working level, and at times appeared to be both *ad hoc* and fortuitous.

Problems of coordination and overlap between FAA and NASA have not been a significant problem in the past because an informal dividing line has existed for years. FAA has concentrated on ATC, short of airborne equipment, and NASA has tended to be concerned primarily with on-board avionics and vehicles. (The SST was an anomaly.) However, NASA has recently showed signs of increasing interest in the field of ATC, and both NASA and FAA were sponsoring what appears to be competing and possibly mutually exclusive approaches to navigation by satellite. A recent White House policy statement appears to have resolved this and defined the roles of the two agencies in navigation aeronautical satellites.

The Office of Management and Budget, though not a performer or originator of research, has played a major role in bringing about the coordination and cooperation among the principal government agencies involved in the performance of civil aviation research and development. OMB was reportedly dissatisfied with the degree of coordination between DOT and NASA FY71 budget submissions, and, as a consequence, the FY72 budgets are being coordinated on a line-by-line basis between the two agencies, and it is expected that this practice will continue.

Similarly, NASA and DOT are working to reconcile their respective interests in experimentation with satellite systems for civil aviation navigation. Both are aware of the role that OMB can play when overt interagency competition and duplication of effort are uncovered.

4. FINDINGS, CONCLUSIONS AND OPTIONS ANALYSIS

a. Overview

Some basic findings concerning the structure of civil aviation R&D can be gleaned from the foregoing discussion. The major problems are:

- Until now the Office of the Assistant Secretary for Systems Development and Technology (DOT) was not adequately staffed. In fact, all of DOT (Office of the Secretary) has suffered from staffing problems.
- There is a conscious organizational split at the policy level between "hard" and "soft" R&D between the Offices of Two Assistant Secretaries. The Office of the Assistant Secretary

for Policy and International Affairs is concerned with “soft” studies; the Office of the Assistant Secretary for Systems Development and Technology is responsible for “hard” studies. This schism makes it very difficult for the Secretary to integrate findings from both sciences to decide what projects can help solve the nation’s transportation problems, and how best to foster their development. We have seen little evidence indicating that the results of “soft” science studies are coordinated appropriately with those from “hard” science to direct technology along potentially fruitful lines.

- The Secretary of Transportation does not have effective and practical control over the modal agencies which are assigned to him, much less over the activities of NASA and DOD (at least as they pertain to civil aviation).
- The statutory responsibilities of DOT and NASA overlap. Thus far, the two agencies have informally adopted a dividing line which may be infringed in the area of air traffic control.
- Coordination among the agencies concerned with aviation research and development is carried on by a number of committees which have been set up between DOT, NASA and/or DOD to promote coordination and cooperation, but much of the best technical interaction seems to arise from the initiative of people at the working level. One must also note the efforts of OMB to prevent, mitigate or eliminate overlaps and duplication of effort.
- Aeronautics has been overshadowed by the space program at NASA over the last ten years, although there are a number of signs that, as funding of the space program declines, the situation is changing.

From our study of the structure of the U.S. civil aeronautics R&D process and considering the findings outlined, we have reached the conclusion that the present organization and procedures of the Federal Government do not ensure the use of limited aviation R&D funds on projects having the highest payoff to the public. We believe that the basic difficulty has been DOT’s inability, thus far, to exercise the leadership in defining a national transportation policy recently called for in Section 3 of the Airport and Airway Development Act of 1970.

Civil aviation R&D is a subset in a hierarchy of national goals and policies. Civil aviation R&D policy is linked to civil aviation policy, which is tied to

national transportation policy, which in turn is only part of an integrated national policy. The whole set of policies quickly gets mired down because in our society — which operates by consensus, and is filled with diverse political interests and competing claims upon the resources of government — it is virtually impossible to construct a set of meaningful national policies beyond general statements of principle. Civil aviation is a particularly difficult area, since it is a service used in varying amounts by various segments of the economy, and its direction and control are not centralized in any one government office.

However, recognizing the impossibility of constructing a set of widely shared national goals, each of the government departments must decide what it is to do, and the President and the Congress must reconcile conflicting claims. The requirement is to operate to the best of our ability in the real world, and find the most optimum solutions it offers. We must utilize each agency's talents, motivate an open discussion of the known and knowable facts, and permit a skillful administrator to synthesize the findings into policy. Each agency must then strive to carry out the decisions logically and in cooperation with other agencies.

Despite the difficulties, there is a process for civil aviation research and development which we believe must be continually pursued. The major elements of this process are:

- Formulate a National Transportation Plan.
- Within the framework of the plan describe the role of civil aviation.
- Assess the current state-of-the-art.
- Catalogue current shortcomings — technical and other.
- Design a plan to overcome shortcomings, consistent with resources, needs, desires, available funding, and the state of nature.
- Allocate money and manpower, and provide guidance to performers of R&D within and without government.

The process for civil aviation R&D thus begins with a National Transportation Plan which, as was pointed out, is a significant problem in itself. The process further implies some difficult questions of organization and decision-making in a highly political atmosphere. The policymaker must be provided with strong analytical assistance so he can understand and deal with issues of technology, economics, societal values, public transportation needs and political forces at the

national, regional and local levels. As shown earlier, an organization which can effectively provide such support does not now exist, and there are substantial roadblocks standing in the way of its establishment. Furthermore, if the policy-maker is able to marshal the needed staff support, he must personally be in a position of influence such that he can deal effectively and decisively with conflicting claims upon our limited resources of money, airspace, radio spectrum, etc.

In view of the foregoing structural weaknesses, a number of options exist for improving the civil aviation R&D process. One category of options has as its objective *to strengthen the ability of DOT to formulate and implement civil aviation R&D policy*. Some basic recommendations to this end are:

- Now that the Office of the Assistant Secretary for Systems Development and Technology (OSDT) is finally adequately staffed, continue to keep it staffed;
- Continue efforts such as those now underway to define transportation system needs;
- Integrate the analyses and findings of “hard” and “soft” systems studies.

A discussion of more detailed recommendations and options for strengthening the DOT’s role in the civil aviation R&D process follows.

b. Options for Strengthening R&D Management Within DOT

We have identified a number of apparent R&D management deficiencies of the Office of the Secretary of DOT (OST/DOT). Most of these stem from the fact that DOT is a relatively new organization with a shortage of qualified personnel. Like any new department, DOT is still tentatively addressing the many complicated issues it is charged with resolving. It has not yet discovered a way to address transportation problems comprehensively to permit rational tradeoffs among the various modal needs.

To some degree, DOT can be compared to the Department of Defense (DOD) during its early years. The Office of the Secretary of Defense (OSD), had a small staff dominated by the three services, each of whom reported to separate Congressional Committees. The entrenched interests of each service and its supporters in Congress nullified the concept of a unified Defense Department. This situation persisted in varying degrees until Robert McNamara became Secretary and was able to coordinate what had been regarded as an unmanageable

situation. Through the innovation of "program packages" and "program elements," OSD successfully directed all activity within DOD toward the achievement of stated defense objectives. Cost effectiveness, systems analysis, tradeoff studies, etc., were first applied on a large scale by OSD. Few, if any, legislative changes were needed to implement this system. In the process, Mr. McNamara earned many enemies but gained control over DOD.

The example of DOD illustrates the general direction in which DOT with its modal administrations will undoubtedly move as it matures. The problems of transportation planning however, are even more formidable than those of defense. The definition of transportation needs, and decisions on how to meet them are essential to any meaningful and effective structuring of our governmental activities in transportation. Presently, identification of needs and frameworks for their satisfaction remain elusive. The problems are usually addressed on a piecemeal basis — mostly because no one within or outside of government seems to have a better method. Furthermore, these are matters of public debate where often there is no "best" answer — thus, decisions are commonly made in the political arena. It is within this context that DOT's performance in civil aviation R&D management must be considered.

1. Coordination of Hard and Soft Science R&D

Recently the concept that technology and societal needs and values can be reconciled at or near the top levels of government has been viewed skeptically. In a number of fields including transportation, R&D programs have been launched without adequate consideration for the actual need for the resultant technology, or for its real or perceived impact on society. This has been particularly true for development programs. Frequently the questions of need and expected impact have not been asked, or have gone unanswered because no one knew how to *find* the answers. Clearly, if we are to exploit fully the potential that technology offers our society, a good deal of R&D in the soft sciences is needed.

"Soft and hard science R&D" should be employed simultaneously, with soft science R&D probably commencing when a research project reaches the applied research stage, and certainly before it enters development. Generally, this occurs in industry. Before a new product or technology enters development, studies are performed on the market, facilities required, capital investment needed, etc. The government must also consider questions of need, social impact, benefit-costs, and finally why it should continue with the R&D, and not industry. In effect, the government should create an environment wherein a checklist of questions would be addressed for each major program.

The Office of the Assistant Secretary for Systems Development and Technology (OSDT/DOT) lacks the appropriate staff to carry this out. Furthermore,

the coordination of hard and soft R&D should take place not only at the “top” of the organization, but at all levels. (In the case of civil aviation, this should apply to NASA at the Research Center level.)

Possible options to be considered by DOT in implementing this concept include the following:

- *Establish a Systems Analysis Office reporting directly to the Under Secretary of Transportation.*

Under this option the final coordination of hard and soft sciences within OST would take place in one office. However, this approach creates another organization layer and would usurp the authority of both the Assistant Secretary for Policy and International Affairs and the Assistant Secretary for Systems Development and Technology.

- *Expand the Office of the Assistant Secretary for Systems Development and Technology to include soft science and systems analysis capabilities.*

This action would considerably improve the ability of this office to make decisions regarding the relative merits of competing R&D programs. There would be overlap between this office and that of the Assistant Secretary for Policy and International Affairs, where most of the soft science activity and talent currently reside.

- *Reorganize DOT along mission rather than modal lines.*

Initially this option would require the Office of the Secretary of DOT to be restructured along mission lines, e.g., short-haul, long-haul, international, etc. This would necessitate the coordination of disciplines and functional organizations around common missions. For example, the short-haul mission office would include both hard and soft scientists drawn from the existing offices of two or more assistant secretaries. If this approach proved successful at OST, it could possibly be extended to the modal administrations; these would ultimately be eliminated with sections of each being combined into various mission offices. A project or mission-oriented organization is considered more costly than a functional organization in terms of staffing duplication, but is able to get a job done more effectively. Usually a combination organization, with project or mission *and* functional organizations, is agreed upon as the best approach.

Considering the magnitude of the DOT task, a move away from modal-toward mission-oriented organization should be further explored as a more

effective means to coordinate hard and soft science research, and to balance the conflicting demands and opportunities afforded by each transport mode.

c. Options for Structuring DOT/NASA Relationships

There was considerable discussion in the Hechler Committee hearings and during our field interviews concerning the organizational fragmentation of civil aviation R&D performance and authority within the Federal Government. Frequently, the suggestion was made to reinstitute NACA. It was implied that removing all aeronautical activity from NASA was necessary to give civil aviation R&D the funds and top-level attention it deserved, and that within NASA aviation R&D would remain overshadowed by space activities.

Key questions to be answered in considering a reinstitution of NACA are: If a new NACA had spent the same funds on civil aviation R&D as NASA has over the past decade, would the results have been significantly better? Would a new NACA have asked for more funds and been successful in obtaining them? These questions are difficult to consider because they are hypothetical and have no definitive answers. To address them, we tried to identify, through interviews with both government and industry personnel, those specific projects and programs in civil aviation R&D which should have been undertaken, and those undertaken which failed *because* of the NASA structure. We were unable to uncover any such programs, although we often heard about characteristics of the old NACA, such as their higher morale, better technical talent, greater top level interest, etc. From our modest interview program, we could see no compelling reason why NACA should be reinstituted, except to have a single organization exclusively responsible for all civil aviation R&D.

Options for restructuring DOT/NASA relationships include:

- *Recreate NACA and Place All Civil Aviation R&D Within It*

The primary advantage of such an arrangement would be organizational purity. A single agency would speak for the civil aviation technical community, and be answerable to the President and Congress for progress in aviation technology by the Federal Government. An improvement in civil aviation R&D would probably result. This "improvement" would have to be balanced against the disruptions a new NACA might cause in terms of current concepts of an overall national transportation policy. Furthermore, constructing a super civil aviation R&D agency would probably necessitate removing air traffic control R&D from FAA and placing it in the new NACA with other aviation-related activities of the Transportation Systems Center of DOT. The Secretary of Transportation would then have no direct control over civil aviation R&D. DOT could, however, treat NACA as a private contractor, i.e., place an order for R&D. Then the new NACA would, in effect, be a captive supplier of DOT.

Moreover, the issue of revising NACA raises a number of questions as to the role of DOT under such an arrangement. Actually many of these questions exist in the present structure of DOT and NASA. In a sense, the old NACA has been submerged in NASA. A statement of civil aviation R&D goals which could presumably come from DOT must be translated into action by NASA. A new NACA would not change this situation. Alternatively, civil aviation R&D policy formulation could be assigned to the new NACA. This would completely contradict the concept of a unified transportation policy which promoted the creation of the DOT.

In sum, a new NACA would not solve the DOT-NASA communications problem (if it is a problem), but it would provide a home for all civil aviation R&D and give it the coherence, unity, and visibility to Congress and the White House that it currently lacks.

- *Place All Civil Aviation R&D Under DOT*

This option would combine the advantages resulting from creating a new NACA and those resulting from placing all civil aviation R&D under DOT. This is most appealing from an organizational viewpoint; the Secretary of Transportation would have day-by-day control over the organization and thus would be better able to insure that its activities were in accordance with overall civil aviation goals. There are, however, some very practical arguments against such a change.

First, it is uncertain whether DOT currently has the technical and managerial competence to effectively administer such an organization. The DOT is a new department and is going through its own growing pains. To give it this added and major responsibility at this time could be a serious mistake, and both DOT and civil aviation could suffer. Second, the aeronautical R&D activities of NASA are spread over a number of NASA Research Centers. Short of physically removing these activities along with their very extensive research and test facilities to new locations, the management of these research centers by both NASA and DOT would create burdensome administrative problems. Another disadvantage would be the isolation of technical personnel and facilities from space activities. In many areas there is no clear distinction between aeronautical and space research; each activity benefits from the other.

As DOT's organizational capability matures, this option might become more appealing. A gradual acquisition of NASA aeronautical activities might also be considered; its ultimate appeal, however, will depend heavily on NASA's response to civil aviation R&D needs as articulated by DOT in the future.

As stated earlier, we were unable to uncover any compelling reasons why such a drastic move is necessary. The relationship of DOT and NASA, especially

with encouragement by OMB to coordinate budgets, seems satisfactory. One reason for this is that DOT has not defined what national civil aviation R&D goals should be; under these circumstances there is no reason why NASA would seem unresponsive to DOT needs.

- *Maintain the Present Basic DOT and NASA Organizations, But Elevate and Expand Aeronautics Role Within NASA and Formalize NASA Aeronautics Budget Requests in Coordination with DOT*

This option points to the desirability of naming an Associate Administrator for Aeronautics, thus elevating the political visibility of aviation R&D activities of NASA. The role of DOT and FAA would remain as currently authorized, with improvements in R&D management mentioned previously. By expanding the scope of NASA aeronautics' research activities, emphasis could be given to development and technology requirements for airports and airways, and the parallel development of a research base in these subsystem areas; also air vehicle interfaces with airports and airways could be examined. Under this expanded scope, the definition of R&D should be broadened to encompass the soft sciences.

This option appears to offer several advantages. It permits DOT/FAA/NASA formalized budget coordination on development and technology support requirements; it elevates the political visibility of aeronautics in NASA; it provides DOT with a research capability in all aspects of civil aviation; and it provides the additional benefits of continued support to DOD. (Recognizing that NASA has a statutory obligation to support DOD in aeronautical research.)

The basic disadvantage appears to be that of not providing DOT with day-to-day control over its research activities.

c. Funding Levels for Aeronautical R&D

Another major conclusion of our R&D management study is that any reduction in, and possibly only the continuation of current levels of funding for aeronautical research, could erode the ability of the United States to compete in the world civil aviation market and could delay or deter the development of the full potential of the nation. Support for this major conclusion must come from

the demonstration of several propositions: First, that civil aviation is important to the people and to the economy of the United States. Second, that the Federal Government and its spending in support of research have constituted a major influence in the accomplishment of research. Third, that a decrease or possibly a failure to increase that support could undermine the continued production by industry of the benefits stated earlier.

The contribution of civil aviation to the economy and to the well-being of the country is widely recognized. It is estimated that in 1967, civil aviation contributed over \$8.0 billion to the Gross National Product, or almost 1.0% of the total. The industry⁹ contributed to the employment of some 830,000 people within the United States, and it contributes about \$2.0 billion per year to our balance of payments position.

This vast and important industry has been able to grow and prosper with the help of substantial inputs of federal funds, both directly and indirectly. In the last 25 years, most of the money spent on aeronautical research has been provided by DOD, with NASA running a distant second. Table II-9 is an effort to factor civil aeronautical expenditures out of the total amount and to reclassify IR&D and B&P funds to their ultimate source, the government. Informed respondents estimate that about 10% of DOD direct spending and overhead reimbursements may benefit civil aviation.

Table II-9 demonstrates clearly that over half of the total funds expended on civil aeronautic R&D originate with the government, and if the SST funds are not considered, DOD provides almost 40% of that. There are three possible dangers on the horizon; decreasing DOD procurement will reduce the total IR&D and B&P money available to industry (since allowed amounts are proportional to sales to the government), direct funding of aeronautic RDT&E by DOD is expected to decline, and, as military and civil applications diverge, the 10% estimated fallout rate will tend to decline.

The character of government and industry contributions to the total civil R&D picture are quite different. Virtually all of the government direct and indirect funding, with the exception of the SST funds, are invested in the area of basic and applied research. The industry funds, on the other hand, are weighted heavily toward development. Of the \$466 million industry funds spent in 1969, about \$150 million was the industry's share of IR&D and B&P, and some \$236 million was expended on development of prototype aircraft alone.

9. The civil aviation "industry" is, in fact, not an industry in the normal sense of the word. As used herein, it means the collection of corporations which contribute to the production or use of civil aircraft.

TABLE II-9
ESTIMATED SPENDING ON CIVIL AVIATION R&D (1969)

	Total Expenditures*	Applicable to Civil Aviation R&D	IR&D and B&P Adjustment	Total Civil Aviation R&D
USAF	797			
USN	461			
USA	134			
Other DOD	<u>2</u>			
Direct DOD	1394	139		139
IR&D and B&P			60	60
NASA	216	95		95
FAA				
SST	94			
Other	<u>32</u>			
Total FAA	<u>126</u>	<u>126</u>	—	<u>126</u>
Total Government	1736	360	60	420
Industry				
Company Funds	466	316		316
IR&D and B&P	<u>600</u>	<u>60</u>	(60)	—
Total Industry	1066	376	(60)	316
Total R&D	2802	736		736

*CARD Internal Working Documents

The pattern that emerges is that the government has been active in funding basic and applied research. The research categories, by their nature, require long lead times, involve higher risk that no commercial application will result directly from a particular project, often require the construction of expensive facilities, and demand the establishment of and continuity of research teams. Such research is usually a more legitimate province of government than industry, as many industries cannot afford the continuity of funding and effort which is so necessary to the building of an effective research base.

Industry has been most active in the development field; and it appears to be an appropriate role for the private sector. Industry has better access to and appreciation of market, economic and societal factors which determine the ultimate success of a particular product. Should the government fail to provide the research funding in the future, a dim prognosis for the industry and our economy can be predicted.

While it is beyond the scope of this project to recommend specific funding levels, we believe it is critical that the government continue to fund civil aeronautic R&D, on a long-term basis, at at least current levels, adjusted for inflation. If, as we suspect, the contribution of the appropriations to DOD decline in their importance, it is clear that NASA, DOT or any new organization set up to augment or replace them be able to pick up the slack. If government does not respond to the challenge, continued technical progress and the economic contribution of the civil aeronautical complex could deteriorate over time. The results may not be felt for 10 or even 20 years, but at that time, there would be no quick way to retrieve the dominant position this country has enjoyed in the world civil aviation market.

III. LEGISLATIVE AND REGULATORY FACTORS

In this section the legislative, regulatory and attitudinal constraints associated with airport development, airport access, airline profitability and long-haul operations are discussed. There are two subsections – “Regulation of Commercial Aviation” and “Airports.” The first contains a comprehensive analysis of the problems and outlook for the commercial aviation industry against the backdrop of Federal government regulation. The second reviews the web of constraining forces currently retarding airport development at major hubs. Following this subsection is an appendix which summarizes the laws and Federal Government programs affecting airports and airport access.

The detailed nature of material presented herein reflects the particular complexity of factors constraining the commercial airline industry and others faced with important airport decisions.

REGULATION OF COMMERCIAL AVIATION

1. INTRODUCTION AND BACKGROUND

There is perhaps no U.S. industry of similar size and importance whose development is so comprehensively and minutely shaped by the forces of government than commercial aviation. From its very inception, the industry has been nurtured by government largess and overlaid with government regulation. Indeed the relationship between government and the commercial aviation industry is no less than familial in character. The government has provided the industry with parental support and protection, while exercising, in turn, a strong measure of parental control.

The questions presented by the relationships between government and the commercial aviation industry are similar to those arising in the family. Is the long-term development of industry being inhibited by too great or insufficient an application of parental control? Would the long-term development of the industry be furthered by greater current enrichment of opportunities at parental cost? Or, would the long-term development of the industry be better promoted by limiting both parental support and control?

While it is perhaps more accurate to distinguish the components of the commercial aviation industry — (1) operators of commercial air transport services and (2) equipment suppliers — when discussing the commercial aviation industry, the distinction is not particularly meaningful when considering the overall relationship of government and the industry. Equipment suppliers are increasingly and largely dependent on aircraft operators for the market for their products.¹ Thus, suppliers, as well as operators, are sensitively affected by the regulatory environment, although operators are more directly affected. The president of a leading manufacturing company asked the question, at the end of a presentation by his marketing staff recommending the introduction of a new product, “Are your prospects’ markets growing fast, and are their operations profitable?” He thus expressed in a nutshell the two practical interdependencies which inextricably link the operators of commercial aviation services and their suppliers, and both segments of the industry to the regulatory environment.

1. The 1970 edition of *Aerospace Facts and Figures*, compiled and published by the Aerospace Industries Association of America, shows that annual industry sales of complete aircraft, engines, propellers, and parts to buyers other than the U.S. Government increased to nearly half of total sales from the 10-15% levels experienced in the early 1950's. Moreover, the backlog of orders by buyers other than the U.S. Government has been over half of the total industry backlog since 1966, and amounted to over 60% of the total backlog in 1968 and 1969.

As these interdependencies relate to the regulatory environment, the questions presented are: to what extent does the present regulation of the air service industry contribute to a maximum feasible rate of growth; does it foster management planning for new types of service; does it encourage experimentation with new services and with the implementation of new technology to extend the market; and does it provide industry with the capability of financing new technology?

2. THE CIVIL AERONAUTICS ACT OF 1938

The Civil Aeronautics Act of 1938 was the basic statute for the economic regulation of the air transport industry. Embodied almost unchanged in the Federal Aviation Act of 1958, its provisions remain the basis for the Civil Aeronautics Board's authority. The Act of 1938 incorporated many of the basic attributes of public utility regulation developed in the 19th century, including many principles from the Act to Regulate Commerce of 1887, which established the pattern for U.S. regulation of transportation and created the Interstate Commerce Commission.

The regulatory agencies are arms of the Congress, deriving their authority from Article I, Section 8 of the Constitution, through which Congress is granted the power "to regulate commerce with foreign nations, and among the several states" There is little wonder that vast confusion on the question of regulation exists, however. The economic basis for regulation stems from the concept of a natural monopoly. If the economic characteristics of an industry require such a high level of capital investment that it is impossible for two firms to exist profitably in the same market, then regulation is required to protect the public. The classic examples of natural monopoly are water, electric and telephone service. The capital investment is so high, and the capital turnover so small (that is, the ratio of annual revenues to total investment), that the market can sustain only a single firm. The U.S. Supreme Court long ago established tests of necessity and monopoly as justification for public regulation of business in the *Munn v. Illinois* decision: "When . . . one devotes his property to a use in which the public has an interest, he . . . grants to the public an interest in that use, and must submit to being controlled by the public for the common good . . ."²

However, the case of the airline industry does not fit the classic pattern of the natural monopoly, although it is clearly clothed with a public interest. While substantial volumes of air services have been and are being supplied in markets where the services of two or more carriers would not be viable and where the duplication of services would involve unnecessary costs, there are numerous

2. 94 U.S. 113, 126.

markets which can and do support economic services by two or more carriers. The rationale for regulation of air transportation is predicated less on the economic characteristics of the industry than on grave national concern with the development of an air transportation system that is "adapted to the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defense." (Sec. 102 of the Federal Aviation Act of 1958, Declaration of Policy.)

Although it is not unusual to charge regulatory agencies with the advancement of the industries which they regulate, the degree of stress that is expressed by the statute in the promotion of air transportation reflects a special concern. The policy declaration of the Interstate Commerce Act, for example, also makes a nod to the promotion of industries regulated by the Interstate Commerce Commission (rail, motor carrier and domestic waterway). However, the Civil Aeronautics Board, as the prime regulatory agency for the air transport industry, is far more heavily burdened with the dual responsibility of regulation *and* promotion.

Sections 102(b) and (f) of the Federal Aviation Act of 1958 declare that, in the performance of its duties, the Board shall consider as being in the public interest, and in accordance with the public convenience and necessity, ". . . the regulation of air transportation . . ." and the "promotion, encouragement, and development of civil aeronautics." Significantly, the precise wording of Section 103(b) of the Act requires that the FAA also consider the "promotion, encouragement, and development of civil aeronautics." The Act's multiple and sometimes conflicting objectives are apparent from a reading of the declaration of policies to be followed by the Board in the exercise of its duties. This Section states the following:

In the exercise and performance of its powers and duties under this Act, the Board shall consider the following, among other things, as being in the public interest, and in accordance with the public convenience and necessity:

- (a) The encouragement and development of an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defense;
- (b) The regulation of air transportation in such manner as to recognize and preserve the inherent advantages of, assure the highest degree of safety in, and foster sound economic conditions in, such transportation, and to improve the relations between, and coordinate transportation, by air carriers;

- (c) The promotion of adequate, economical, and efficient service by air carriers at reasonable charges, without unjust discrimination, undue preferences, or advantages, or unfair or destructive competitive practices;
- (d) Competition to the extent necessary to assure the sound development of an air transportation system properly adapted to the needs of the foreign and domestic commerce of the United States, and the Postal Service, and of the national defense;
- (e) The promotion of safety in air commerce; and
- (f) The promotion, encouragement, and development of civil aeronautics.

As various students of the Act have noted, policies designed to optimize one goal often preclude optimizing another. For example, the requirement of Sec. 102(b) to regulate air transportation to “assure the highest degree of safety” can readily be at cross-purposes with the requirement to “foster sound economic conditions.” The requirement of Sec. 102(a) to encourage and develop a system “properly adapted to the present and future needs, . . .” poses a dilemma if the present needs require different policies from the future needs. Similarly, the promotion of service “at reasonable charges” may not be consistent with “competition to the extent necessary to assure the sound development of an air transportation system,” or with the “encouragement and development of an air transportation system properly adapted to present and future needs of the foreign and domestic commerce . . .”

It has been observed by one analyst that the statement of policy “apparently . . . requires an impossibility of the Board; on the one hand, and leaves it with considerable freedom of action, on the other.” He goes on to suggest that it is literally incapable of realization, but that more realistically it “identifies a number of desirable goals and leaves it up to the Board to choose which ones it will pursue.”³

The details of the CAB’s powers and duties with respect to economic regulation are contained in Titles IV and X of the Act of 1958.

3. Richard E. Caves, *Air Transport and Its Regulators*, Harvard University Press, 1962, p. 127.

Title IV, Air Carrier Economic Regulation, consists of 17 major sections. Section 401 provides for Certificates of Public Convenience and Necessity; Section 402 deals with the requirements for Permits to Foreign Air Carriers; Section 403 outlines the requirements for Tariffs of Air Carriers.

The carriers' duties to provide service of persons, property and mail and the determination of rates are covered by Sections 404-406. Section 407 deals with the filing of accounts and reports. Section 408 is an important one dealing with the powers of the Board regarding consolidation merger and acquisition of control. Section 409 describes the Board's powers to prohibit interlocking relationships, and Section 410 discusses the Board's powers with regard to financial aid and loans. The Board's investigative powers are enumerated in Section 411. Sections 412-417 describe the powers and responsibilities of the Board with regard to pooling various exemptions and special authorizations, including immunity from the "antitrust laws" under certain circumstances.

Title X contains the procedural requirements to which both the Board and the Federal Aviation Administration are subject. Among the nine sections of Title X are sections on the conduct of proceedings and the examination of the Board's investigative powers. Section 1003 provides for joint procedures with the Interstate Commerce Commission, and other sections provide for the taking of evidence, issuing of orders and for judicial enforcement and review.

Most briefly, the Act confers on the Board plenary powers to regulate virtually every facet of the industry's structure, operations, and relationships to other industries. These powers include:

- The licensing or granting of operating authority (routes);
- The regulation of rates (pricing);
- The regulation of relationships among air carriers and between air carriers, common carriers, and other aeronautical firms;
(cooperation and collusion)
- The granting of subsidy;
- Enforcement of laws, regulations and procedures.

3. LICENSING AUTHORITY

With several exceptions, commercial aircraft operations conducted within and to and from the U.S. require the express authorization of the Board. Commercial operations conducted wholly within the boundaries of a single state do not require such authorization, provided that the purely intra-state operations do not participate in the movement of persons and goods in interstate commerce or constitute a significant burden on operations that are conducted in interstate commerce. The most important of the air transport services which are conducted, as intra-state services, outside of the immediate jurisdiction of the Board, are the intercity passenger air services operated in California and Texas. Additionally, the Board has exempted from the requirement for certification of authority those air carriers that limit their services, as matter of administrative discretion, to operations with aircraft weighing 12,500 pounds or less. An increasing volume of services by air taxi and air commuter carriers falls in this category.

While the Board has been given extensive powers to authorize and limit the scope of air services, it also has been denied powers to control directly the volume of services offered or the types of aircraft used in the provision of the services offered. This limitation on the powers of the Board over services is significant because it reflects a Congressional intent to preserve to airline management the latitude to choose flight equipment and to pattern flight services free from regulatory direction and control. The Board is empowered only to prescribe directly a minimum level of service that meets the standards of adequacy required by Sec. 404 of the Act.⁴

In the absence of a direct control over the scheduling services, the Board has characteristically used its powers to authorize competitive service as a means of achieving and enforcing a higher standard of service. The lack of satisfactory services is frequently cited by the Board in justifying the authorization of duplicating, competitive services, and even the threat of such competitive authorizations has been known to be effective in producing substantial increases in services.

In the exercise of its licensing authority, the Board has pursued several consistent policies, though the degree of emphasis among the individual policies varies in accordance with economic conditions in the industry.

4. Sec. 404 states, in pertinent part, that: "(a) It shall be the duty of every air carrier to provide and furnish interstate and overseas air transportation, as authorized by its certificate," and further, "to provide safe and adequate service equipment and facilities in connection with such transportation."

- The scope of authorized services is being expanded to provide for more direct services between pairs of points, eliminating the necessity for aircraft stops and connections between flights of the same and different carriers.
- The degree of overlap in service authorizations and the number of competitive services authorized in individual markets is being increased, though the pace of authorization is slowed when the industry experiences adverse financial conditions.
- Newly authorized services are awarded to foster greater opportunity among carriers to achieve economically viable operations and to reduce the need for subsidization of loss services.
- Specialized supplementary services are authorized and sustained to promote development in areas in which it is felt that carriers providing basic services have limited or conflicting interests.

The evolving structure of air services has been accompanied by a rapid growth in air transportation. It is now the leading medium of passenger intercity travel by common carrier within the U.S., and in travel to and from the U.S. It follows the private automobile as a leading medium of all travel within the U.S. for passengers making intercity trips in excess of 500 miles. (See Table III-1 below.)

In contrast to the airlines' early dependence on government subsidy, in the form of compensation for the transportation of mail,⁵ the airlines are today subsidy-free with the exception of regional carrier operations within and outside the limits of the continental U.S. Moreover, the evolving air transport industry has demonstrated unquestionably a capacity to attract substantial sums of private capital to modernize and expand its aircraft fleet and ground facilities.

However, the policies pursued by the Board in the exercise of its certification powers have not met with universal or uniform success. Authorized services to small communities, in a significant number of cases, have not produced desired

5. Sec. 406(b) of the Act states that in the establishment of mail rates the "needs of each...air carrier for compensation for the transportation of mail sufficient to insure the performance of such service and, together with all other revenues of the air carrier, to enable such air carrier under honest, economical, and efficient management, to maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service, and the national defense."

TABLE III-1

PERSON-TRIPS – DISTRIBUTIONS BY TYPE OF TRANSPORT AND TRAVEL AND HOUSEHOLD

Characteristics: 1967

Distribution by Type of Transport

Travel and Household Characteristics	Person-Trips		Percent Distribution by Type of Transport					
	Million	Percent	Auto	Bus	Train	Commercial Air	Ship or Boat	Combinations & Other
Distance (One-Way Straight-Line Miles)								
Less than 50 miles	35.4	100.0	95.2	2.3	1.0	0.1	0.9	0.5
50 to 99 miles	73.5	100.0	95.9	2.6	0.7	0.1	0.2	0.5
100 to 199 miles	118.6	100.0	93.5	2.6	1.1	1.8	0.1	0.9
200 to 499 miles	71.6	100.0	80.6	3.1	1.6	12.2	—	2.5
500 to 999 miles	23.2	100.0	61.9	2.3	4.3	27.8	—	3.7
1,000 miles and more	21.8	100.0	55.5	1.5	3.2	36.6	0.1	3.1
Outside United States	14.9	100.0	63.8	3.9	0.6	22.8	5.1	3.8
No answer	2.2	100.0	96.2	0.7	0.5	2.6	—	—

Source: U.S. Department of Commerce, 1967 Census of Transportation, National Travel Survey, Table 7, page 21.

and expected traffic development and economically tolerable services, with the result that direct authorized services have been withdrawn from 41 community airports within the past ten years.⁶ Short-haul air services and air passenger travel for trips under 250 miles have decreased in relation to total air services and air travel and have failed to achieve as great a penetration of the total short-haul market as many authorities believe to be feasible. The growth of air cargo services and traffic, while substantial, has fallen far short of the high expectations for this segment of the air transport industry.

Finally, it has been and is being urged that even the development of long- and medium-haul air passenger services and traffic has been inhibited both by an excess of competitive authorizations and by an insufficiency of such authorizations. The proponents of less competition argue that the reduction in the intensity of competition will result in the ability of carriers to tailor capacity more closely to traffic demand and thus maintain higher load factors and avoid the needless cost of unutilized capacity. By passing these cost savings to the public, in the form of lower fares, it is maintained that the market will be expanded and the demand for aircraft capacity correspondingly increased. Proponents of greater competition argue that the only practicable assurance of a continuing high standard of service available to the public when desired, at rates in line with the costs of providing the service, is effective competition that affords the passenger a choice of services and a means of expressing preferences among innovative alternatives.

It is plain that the Act affords the Board the wide latitude to place the air transportation system in a highly competitive posture, providing to certificated air carriers the freedom to enter and leave markets at will. Alternatively, by applying restrictive certification policies and by the encouragement of mergers and consolidations, the Board can place the air transportation system in a protective monopoly posture.

The past and present policies essentially are a compromise between the extremes of complete freedom of entry and competition, and a wholly protected air transportation system designed to minimize the subsidy burden and the likelihood of individual carrier failure. A review of route awards in more than thirty years of regulatory experience discloses a steady shifting of the regulatory center of gravity in the direction of competition.⁷ In part, depending upon the

6. In 1959, 566 U.S. domestic airports were certificated for service; but, by 1969, the number had decreased to 525, according to F.A.A. tabulations reported by the Air Transport Association in *Air Transport Facts and Figures*.

7. Analysis of CAB Competition data for 1967 describe that 67.4% of passengers in all scheduled markets have a choice of competitive services, and that 69.3% of the passenger-miles are served competitively. Competition is defined as no one carrier obtaining over 90% of the individual city-pair markets.

philosophies of individuals comprising the Board and, in part, on the Board's perception of economic conditions in the industry at the time, competition has been extended — at slower or faster rates — but more or less consistently throughout the air transportation system. As density of traffic has increased, more overlap has been provided between the authorized services of certificated carriers. In some cases the Board may have initially denied applications for competitive services and then reversed itself, sometimes no later than a year, in authorizing competitive services for the same routes over which competitive services had been denied earlier. The domestic air route structure is now mainly competitive, as more than half of the U.S. domestic air passengers have a choice of competitive services.

However, while competition in the basic structure of air routes has been extended, freedom of entry has been restricted. The increased competition has been accomplished by rearranging and extending the operating authority of carriers already holding certificates of public convenience and necessity. In 1938, for example, only one airline (Eastern) held operating rights to transport domestic passengers between New York and Miami. Today, three carriers are authorized to do so, but the two additional carriers (National and Northeast) held operating rights as trunkline carriers in 1938.

While the entry of new carriers into the basic trunkline air route system has been rigorously restricted and, indeed, the number of trunkline carriers has decreased steadily through mergers and acquisitions, the Board has authorized new and specialized services that mainly supplement but also overlap trunkline services in varying, but limited degrees. Since World War II, the Board has authorized the services of local service carriers (also referred to as regional carriers), initially as specialists in short-haul air transportation between markets of relatively light traffic density. All-cargo carriers have been authorized to engage in the transportation of freight express and mail cargo. Supplemental air carriers (also referred to as large irregular air carriers) have been authorized to engage in charter activities, transporting both cargo and passengers in plane-load lots. Helicopter carriers have been certificated to provide local services within urban areas, between airports within the areas and between airports and major concentrations of passenger origination and destination within the area. More recently, by providing the umbrella of a blanket exemption, the Board has permitted the development of scheduled air taxi and commuter services with small aircraft.⁸

8. Part 298 of the Economic Regulations of the Board establishes a classification of air carriers designated as "air taxi operators." Included in this classification are air carriers which do not use propeller aircraft larger than 12,500 pounds in maximum certificated take-off weight or turbo-jet aircraft having a maximum certificated take-off weight of under 27,000 pounds (in plane-load charters only) and which do not hold a certificate of public convenience and necessity. These carriers are exempted from the various sections of the Federal Aviation Act that would otherwise prevent the carriers from providing direct air transportation of passengers and/or property, and/or transportation of mail between points within the 48 contiguous states, Alaska, or Hawaii. By Order 70-1-15, dated January 1, 1970, the Board initiated an investigation in Docket 21761 to determine whether the 12,500-pound weight limitation restriction should be changed. This proceeding is presently in progress before the Board.

The reasons advanced for the trend of specialization are twofold: First, it has been held that specialized services, if entrusted solely to trunkline carriers, would suffer from lack of attention and development because the trunklines would be more likely to devote management and capital resources to their more lucrative and established longer-haul passenger services. Second, it has been held that specialized carriers, lacking the opportunities available to trunklines, would have greater incentive to spur the fullest development of specialized services.

The certification of specialized services has met with mixed success. Of the six carriers that have been awarded certificates to engage in exclusive air cargo services, only three are operating today. Of the four helicopter carriers to which certificates have been awarded, all are in serious financial straits. The local service industry, notwithstanding recent route awards designed to strengthen it, is experiencing operating losses and is pressing for additional subsidy. Economic attrition has decimated the ranks of carriers initially authorized to provide supplemental charter services. While air taxi and commuter services have proliferated, there is little or no evidence that any significant sector of the industry has attained economic viability. There is great instability and an increasing number of bankruptcies among these air carriers.⁹

Despite the lack of economic success, the specialized air carriers clearly have been artistically successful in filling the roles for which they were authorized. The local service carriers have brought about a more rapid and intensive development in short-haul services than reasonably could be expected to have been brought about under exclusive trunkline operation. The studies of the Board show that communities served by local service carriers have received more and better short-haul services than communities of like traffic potential served by trunklines. Air cargo and supplemental air carriers have exerted an effective, if limited, pressure on the pricing policies of the trunkline air carriers. In the case of air cargo carriers, they have been instrumental both in stimulating the development of the air cargo market and of exclusive cargo services tailored especially to the movement of freight rather than incidental to the movement of passengers. The supplemental carriers have been instrumental in developing the group travel market and in accelerating the introduction of lower-priced coach and economy services throughout the basic route system.

One explanation, it might be noted, that has been advanced for the lack of success of specialized service programs authorized by the Board is the timidity with which the Board has defined the scope of specialized service operations. It has been suggested that the specialized carriers have not been granted sufficient operating authority to enable them to effectively and economically perform their

9. The records of the National Air Taxi Conferences (NATC) disclose that 17 NATC member air taxi operators declared bankruptcy in the first 10 months of 1970.

specialized services, and to provide a sufficiently large market for new technology which would increase the economy and quality of the specialized services. It has been urged that the very limited scale of experimentation with specialized services contributes to the lack of success of the experimentation by not affording the opportunity to employ the full benefits of technological advances available for application.

The overall certification policies and procedures of the Board are only incidentally pursued with an eye to the airline industry's potential for the effective and efficient use of new technology. Decisions with respect to the ordering of route proceedings and the award of operating rights are rarely made in the light of prospective technological developments, unless the developments are imminent. The future horizon for decision-making in route proceedings is usually no more than two years ahead. A further look into the future customarily is discouraged as being too speculative. As a result, decisions are made without specific consideration of the threshold of traffic density requirements for viable competitive services with newer types of aircraft, and without specific consideration of the modifications in operating authority required to take the fullest advantage of operational capabilities of improved aircraft types. It is indicative of the lack of consideration of impending technological developments that the Board, to date, has decided international route cases that fix the structure of international air routes for years to come without an overt consideration of the possibilities of supersonic transport aircraft, although the development of the Concorde is well under way and an American SST is on the horizon.

A lack of insight with regard to impending technological developments causes lags in the adaptation of the service structure to the needs of the market and the capabilities of new aircraft. For instance, direct nonstop services between Chicago and Hawaii were not authorized until many years after market and aircraft technology were capable of sustaining the service.

It also has been contended that a lack of insight into developing technology, particularly as to the increasing traffic requirements for economic and efficient operations of new generations of larger and more productive aircraft, is responsible for an over-authorization or a premature authorization of competitive services. Whether an over-authorization of competition, in fact, exists is a matter of great debate, but there is little question that the Board's myopic look ahead in certificate proceedings gives it limited, if any, insight into the implications of new aircraft for flight frequencies, attainable load factors, or the traffic requirements for profitable operations with new aircraft.

The failure to achieve a full accommodation of the air route system and technology entails costs in the form of 1) a loss of realizable traffic growth potential and 2) a loss in realizable profit potential. These costs, in turn, reduce the ability of the industry to make maximum effective use of new technology. The loss of traffic growth directly reduces the industry demand for new aircraft; the loss of profits reduces the capability of the industry to finance the purchase of new aircraft and further constrains the market for new technology.

A recent proceeding initiated by the Board heralds a possible change in certification policies and procedures. In October 1967, the Board instituted an investigation to determine the need for and feasibility of metropolitan area to metropolitan area VTOL, V/STOL, and STOL services in the Northeast Corridor.¹⁰ The Board invited participation in the proceeding by aircraft manufacturers to present evidence concerning operational and economic characteristics of new aircraft types and plans for production, stating that it was the understanding of the Board that aircraft capable of producing the intercity services on an economical seat mile basis were technologically feasible and could be produced if there were an adequate market to provide the economic incentive for doing so. The first phase of the investigation now has been completed and the Board has found that V/STOL services in the Northeast Corridor are both necessary and feasible.¹¹ The Board further found that a chief obstacle to the achievement of necessary V/STOL services in the Corridor "has been the cycle of inaction that has affected the participants in its development: local authorities lack incentive to develop landing sites in the absence of some assurance that appropriate V/STOL aircraft will be available to use them, manufacturers are reluctant to begin active production of aircraft until they have sufficient orders, and carriers are unwilling to order equipment unless they can look forward to suitable landing sites."¹²

The Board now, three years after the initiation of the investigation, has launched the second phase of the investigation to consider in detail which V/STOL services should be authorized in the Northeast Corridor on a subsidy ineligible basis; and to consider more fully the question of landing sites, including their locations, field and terminal design, access roads, cost estimates, and plans for funding. It is likely that at least two more years will elapse before the second phase of the case is concluded.

The proceeding before the Board, which is concerned with the modification of the weight limitation on exemption authority for air taxi services under Part 298, also has important future technological implications. But, characteristically, the evidence requested in the proceeding, as a basis for the Board's

10. *Northeast Corridor VTOL Investigation*. CAB Docket 19078, instituted by Order No. E-25779, dated October 4, 1967.

11. Order 70-9-44, dated September 8, 1970.

12. *Ibid*, page 4.

decision, according to the Prehearing Conference Report of Examiner Merritt Ruhlen, dated May 12, 1970, is limited to operations for the year 1971. For all practical purposes, therefore, the Board's decision will be based on current technology. Presumably, further consideration of the need for changes in Part 298 resulting from new technological developments will await another proceeding, instituted after the developments have occurred, before the regulatory authority can be adapted to technological developments.

4. PRICE REGULATION

The Board's powers with respect to the rates and charges of air carriers are comprehensive. The Board is empowered, under Section 1002 of the Act, to review rates, fares, and charges of air carriers, in interstate and overseas air transportation upon complaint or on its own initiative, and to determine whether the tariffs of the air carriers are "unjust or unreasonable or unjustly discriminatory or unduly preferential, or unduly prejudicial." The Board is further empowered to prescribe rates, fares, and charges which it believes to be lawful, except that, as to overseas air transportation, the Board may determine and prescribe only maximum and minimum rates.

The Board's powers with respect to rates in foreign air transportation are more circumscribed by the statute covering the review of rates for the purpose of correcting unjust discrimination, undue preference, and undue prejudice. No direct powers to review the reasonableness of foreign rates are conferred on the Board. However, the power to approve or disapprove agreements among carriers under which foreign rates are established effectively endows the Board with virtually the same powers of control as it holds over domestic and overseas rates.

The guidance, which the Act gives to the Board for the exercise of its powers over rates, allows the Board wide latitude in the formulation and application of rate policies. Within the four corners of the standards that are laid out for guidance in Section 1002(e), the Board is charged with balancing the interests of users in low rates, the interests of carriers in adequate profit margins, and the impact of rates on traffic movement and the quality and quantity of service.¹³

13. Section 1002 (e) states that the Board shall take into consideration, among other factors:

- (1) The effect of such rates upon the movement of traffic;
- (2) The need in the public interest of adequate and efficient transportation of persons and property by air carriers at the lowest cost consistent with the furnishing of such service;
- (3) Such standards respecting the character and quality of service to be rendered by air carriers as may be prescribed by or pursuant to law;
- (4) The inherent advantages of transportation by aircraft; and
- (5) The need of each air carrier for revenue sufficient to enable such air carrier, under honest, economical, and efficient management, to provide adequate and efficient air carrier service.

Over the years the Board has used its considerable direct powers in rate determination quite sparingly. In 30 years of regulation, for instance, there has been only one completed general investigation of passenger fares and a second one is currently under way. However, even without exercising its direct powers to prescribe rates, the Board has wielded a strong influence over both rate levels and structure. This influence has been used, in general, to produce the following developments in the level and structure of rates:

- Overall rate levels have been related to costs, except in the case of short-haul air services where it has been maintained that value-of-service considerations place a ceiling on rate levels.
- A high degree of rate differentiation has been built into the rate structure, providing for a wide variety of discounts from basic rates to encourage greater use of air transportation and more balanced traffic flows.
- Rate levels have been reduced in an effort to bring air transportation within the reach of an increasing share of the population.

Under Board influence and direction, the basic passenger rate structure has been reduced from first class levels to coach and economy levels, as the basic service has moved from a first class service to the higher density coach/economy service. This transition in basic services also was a product of changing aircraft technology in which weight-limited aircraft of the propeller generation were superseded by space-limited aircraft of the jet generation. Weight limited aircraft do not economically lend themselves to high density seating configuration since the additional weight of added seats reduces the overall payload availability; on the other hand, space-limited aircraft do lend themselves to high density configurations in which more passengers are accommodated in the same limited space without exhausting the weight-carrying capacity of the aircraft.

The Board also has introduced an increasing degree of "taper" into the passenger fare structure increasing the fares per mile proportionately for passengers traveling shorter distances than for passengers traveling longer distances. This has been done by modifying the fare structure to add the same amount to each ticket, without regard to distance. However, it is generally agreed that the current passenger fare structure still does not make provision for high enough fares for

shorter distance trips to compensate the carriers fully for the shorter distance services. A Board staff study, published in 1968, concluded:

“Although the current fare structure possesses a moderate degree of taper, the current cost analyses indicate that a greater taper is warranted than now exists in the fare structure.”¹⁴

The uneconomic relationship between short-haul costs and short-haul fares, which is embodied in the fare structure, is generally justified by the lesser value that is attached by the traveler to air services, where the distance involved makes surface transportation an acceptable alternative. Thus, it is argued that higher prices would discourage use of short-haul services. Whatever the merits of maintaining short-haul rates below economic cost levels, it is this facet of the fare structure which explains the lack of interest of the airlines in investing substantially in short-haul aircraft technology.

The Board also consistently has maintained a downward pressure on fares in medium and longer distance markets, permitting fare increases in these markets only reluctantly and on showing of great distress by the airline industry. Moreover, when fare increases have been granted, pressures also have been exerted to increase the number and effectiveness of discount and promotional fares which reduce revenue yields.

It may be expected that a clearer expression of Board policy will emerge from the investigation of passenger fares currently under way. But, this investigation, divided in nine separate parts for administrative manageability, is an excellent illustration of the regulatory difficulties of dealing expeditiously and effectively with the variegated structure of fares which the industry has evolved. As the investigation shows, the setting of adequate levels of rates to provide for a reasonable rate of return has become an extremely cumbersome process. Not only must the interest of various segments of the air carrier industry be reconciled, but also the interests of various air carriers of the same classification, who champion different methods of costing or cost allocation. Furthermore, considerable differences even among air carriers and between air carriers and the Board's staff about the elasticity of the air traffic in relation to price, as well as the long-run trends in costs, does not assure that the domestic air fare investigation will come to clear-cut and generally accepted conclusions.

The complexity of this investigation, which mobilizes the efforts of a large portion of the Board's staff, as well as the staff services of air carriers, precludes frequent review of overall domestic air fares. Thus, the present investigation was

14. *Staff Report: A Study of the Domestic Passenger Air Fare Structure*. Rates Division, Bureau of Economics, Civil Aeronautics Board. January 1968, page 68.

started only after the majority of trunk carriers failed to earn adequate rates of return for three years. The long elapsed times between exercises in fare setting, and the lengthy time for reaching a fare formula certainly make it unlikely that the industry can look to the regulatory agency for immediate relief in times of adversity or can safeguard its profits through flexible pricing which requires regulatory review. This developing threat to the long-run profitability of basic medium- and long-haul services has a direct bearing on the status of the industry as a market for new aircraft technology.

The main thrust of passenger rate regulation has been in the direction of maintaining a ceiling on passenger fares; cargo rate regulation, on the other hand, has been mainly directed to keeping a floor under cargo rates. The difference in direction results from the fact that a substantial volume of cargo service has been and continues to be moved in combination aircraft transporting both passengers and cargo. Operators of combination services characteristically view cargo as a by-product of the basic passenger service. For the operator of combination services, cargo revenues in excess of the costs of handling the cargo on the ground represent a contribution to system overhead and profit. Operators of all-cargo aircraft services must include the costs of aircraft operations in determining the net profit or loss from cargo traffic, in addition to the costs of ground handling.

Differences in the costing philosophies of combination and all-cargo carriers have been reflected in differences between the two groups respecting the appropriate levels of air freight rates. These differences induced the Board, in 1948, to promulgate minimum rates based on its determination of the costs of all-cargo services. Thereafter, Board regulation of cargo rates has been concerned largely with the maintenance of minimum rates at levels high enough to preserve all-cargo services. The recent introduction of Boeing 747 services by combination carriers promises to deepen the Board's concern since the belly compartments of the 747 contain as much cargo-carrying capacity as the holds of most present-day all-cargo aircraft.¹⁵

Despite the Board's past and present concern with the maintenance of minimum cargo rates at economic levels, all-cargo services have been either marginally profitable or unprofitable according to reports of profit and loss filed with the Board since 1963.¹⁶ The failure of all-cargo services to achieve satisfactory and sustained profit levels has discouraged the adoption of new technology.

15. The 747 belly holds approximately fifteen 350 cu ft containers and 800 cu ft of open bulk space (6,050 cu ft total); by comparison, the B-707-320C carries thirteen 310 cu ft igloos and 1,720 cu ft of belly cargo (5,750 cu ft total).

16. Form 42, "A Report of Scheduled Air Cargo."

Regulatory concern with minimum rate levels has slowed innovative rate-making, since proposed new rates at low promotional levels are likely to encounter opposition and, as a result, become the subjects of protracted Board deliberation. It is significant, in this connection, that the revenue yields and light density shipments per ton-mile of domestic all-cargo carriers, the composite average of rates received, bottomed out (in current dollar terms) in 1964 at 13.5 cents per ton-mile. By comparison, domestic air passenger yields per revenue passenger mile showed a decreasing trend until 1969.

The price structure for air freight services has presented the industry with significant technological problems and opportunities. The air transport industry, under the prevailing price structure, attracts a sizable volume of small and light density shipments. Surface carriers discourage these shipments by onerous rate penalties and, in some cases, by tariff rules which make the shipments totally unacceptable for surface transportation. The handling and transportation of small and light density shipments are substantially more costly than the handling and transportation of larger and denser shipments under existing technology. There is considerable margin for improvement of economics both in ground handling equipment and procedures and in aircraft design.

5. REGULATION OF EXTERNAL RELATIONSHIPS

Intercompany and external relationships of air carriers are subject to Board approval and control under Sections 408, 409, and 412 of the Act. Broadly, these sections of the Act cover relationships among air carriers, between air carriers and common carriers, and between air carriers and persons "engaged in a phase of aeronautics." The relationships under the jurisdiction of the Board include virtually any and all transactions and arrangements which have a material effect on the economic status of the individual air carrier, the performance of its transportation functions, and its market power relative to competing air carriers. These external relationships include:

- The consolidation or merger of properties for the purpose of ownership, management, or operation of the properties;
- Purchase, lease, or contract to operate properties;
- The acquisition of control;
- Interlocking office-holding and directorates;
- Contracts affecting air transportation and agreements "for pooling or apportioning earnings, losses, traffic, service, or equipment, or relating to the establishment of transportation

rates, fares, charges, or classifications, or for preserving and improving safety, economy, and efficiency of operations, or for controlling, regulating, preventing, or otherwise eliminating destructive, oppressive, or wasteful competition, or for regulating stops, schedules, and character of service, and for other cooperative working arrangements.”

Concern with the preservation of effective competition within the air transport industry, and between the air transport industry and other competing modes of transportation bulks large in the Board’s regulation of the external relationships of air carriers. Sec. 102 charges that the Board consider as being in the public interest “competition to the extent necessary to assure the sound development of an air transportation system properly adapted to the needs of the foreign and domestic commerce of the United States . . .” Sec. 408(b) directs the Board to judge proposed mergers and consolidations by the standard of the public interest, provided “that the Board shall not approve any consolidation, merger, . . . or acquisition of control which would result in creating a monopoly or monopolies and thereby restrain competition or jeopardize another air carrier not a party to the consolidation, merger . . . or acquisition of control . . .”

The Board, in general, has shown great reluctance to approve any mergers of air carriers except with other air carriers. It appears to have reasoned that the primary mission of the air carrier industry would face danger of dilution if carrier management were permitted to engage in types of transportation activity other than direct air service, or if the interests of other types of transportation were to get superseding consideration. However, from the viewpoint of technological innovation, the inability of air carriers to engage in all the activities of physical distribution — freight collection, consolidation, local transportation, handling and distribution and the control and economic benefit from these activities — has had a dampening effect on innovation. Trucking companies, for example, are better able to design functional transportation systems by virtue of their ability to control and to perform a complete door-to-door service. Similarly, rail piggyback service enables the railways to extend its operations to offer complete customer-oriented service. With a very few exceptions, however, the Board has endeavored to preserve the integrity and isolation of air carriers by taking only the most tentative steps toward permitting air-surface consolidation or any type of vertical integration (i.e., supplier-industrial user relationships).

Under applicable Board policies, the combination of air carriers has had a generally beneficial effect in creating better opportunities for the implementation and use of new technology. A case in point is the marriage of convenience in which, from time to time, a chronically troubled carrier is merged into a stronger carrier in order to preserve service to the public and employment of the failing firm’s resources. The Project Horizon report of a decade ago noted that the need

for consolidation of carriers was often a consequence of a major re-equipment cycle, and suggested that, in the light of the increasingly high stakes resulting from rounds of purchasing new aircraft, "consideration should be given to the possibility of further mergers among both trunkline and local service carriers" in order to insure sound economic conditions in the industry.

Further, the Board typically considers, in its review of merger proposals, the ability of the candidates for merger to achieve operating efficiencies as a result of the proposed merger, and looks for the ability to reduce subsidy by strengthening routes. It considers the ability to utilize employees more effectively, and to consolidate ground facilities and personnel. These are considerations which bear strongly on the capability of the merged carrier to acquire and make effective use of new technology.

In addition, service improvements, such as the ability to offer single-plane service to important city-pair markets is taken into consideration, along with the preservation of competition and the maintenance of competitive balance between carriers. These are considerations in the Board's approval of proposed mergers that also add to the opportunity and propensity of air carriers to make use of new technology.

The Board spelled out its historic considerations in *Frontier Airlines, Inc. – Central Airlines, Inc., Merger* (1967) as including

- The possible integration of two systems through cost savings resulting from common use of personnel, facilities and equipment, and through improved public service resulting from the operation of through flights;
- Whether the price is reasonable with reference not only to the two carriers but also to the minority stockholders, the public, and the Federal Government;
- The economic impact upon each carrier's personnel and what provisions are available for minimizing any adverse effect;
- The extent to which the combination of the two carriers would create a monopoly or restrain trade and thereby jeopardize another carrier or carriers; and
- The extent of the diversion of revenues from competing carriers and the effect thereof.¹⁷

17. *Frontier Airlines, Inc. – Central Airlines, Inc., Merger*, Docket 18517, page 9.

During 1969 the Department of Transportation expended considerable effort on preparing policy guidelines by which to evaluate proposed mergers. Although no official application of these guidelines has yet been made, it appears that the Department wishes to be able to make rational evaluations of proposed mergers in order to determine whether it should intervene as a party before the CAB. The project, under the direction of the DOT Office of the Assistant Secretary for Policy and International Affairs, devised guidelines in seven principal areas:

- *Competition.* The Department suggested that any proposed merger involving carriers competing in perhaps 10-12 of the top 135 city-pair markets would substantially diminish competition.
- *Market Share.* A second criterion was that no merger should result in the merged carrier taking a considerably larger portion than the largest carriers now do of either the domestic trunkline market, the total domestic market, or the total of U.S. airline traffic in the world market.
- *Concentration.* The department suggested that shifts in concentration of the top four and top 10 airlines in the three major market categories should be considered.
- *Effect on Other Carriers.* Injury to other airlines, the likelihood of starting a round of defensive mergers, and other airlines' reactions were included in the guidelines.
- *Financing.* The strengthened financial position of merged carriers should be evaluated from the standpoint of ability to obtain new equipment or, under circumstances of a merger to rescue a failing business, the prospects for sustaining the failing carrier should be evaluated.
- *Economic Benefits.* The opportunities for schedule and operating improvements and benefits of counterseasonality of traffic would be considered.

The Board has characteristically walled-off the airlines in an effort to preserve the main thrust of management attention in aviation. This has had a secondary purpose, also consciously pursued by the Board, to avoid giving any one carrier excessive strength and market power.

The Board has condoned limited cooperative arrangements in the industry, among them the operations of Air Cargo, Inc. and Air Express. The major

question raised by the limited experiments that have been attempted is whether such efforts provide sufficient opportunity for the development of interface technology. As we shall see in the discussion on subsidy, the effect of subsidy experiments under the Board has been to punish severely wrong judgments on the part of carrier management, but not to reward successful decisions. The result has been an unfortunate bureaucratization of management decision-making that has served to stifle technological innovation.

More recently, the policies of the Board with respect to common control and operations of surface and air transportation have been relaxed to permit an increasing amount of common services. A study by the Bureau of Economics of the Interstate Commerce Commission suggested that air and truck freight services were rather more complementary than competitive, and that "the fundamental nature of air and truck services naturally encourages a high degree of cooperative effort."¹⁸ The number of points receiving direct air carrier service is relatively small and does not change substantially over time, the study pointed out; by contrast, the number of points provided with air cargo service in coordination with truck lines is large and is increasing.

In a recent initial decision of the CAB Hearing Examiner, served September 22, 1970, however, two large western railroads have been granted permission under Section 408 to enter the air freight forwarding business. The two railroads are the Southern Pacific, through its subsidiary Southern Pacific Air Freight, and the Santa Fe through the acquisition of Express Air Freight, Inc. The decision in part turned upon the Board's earlier decision permitting the entry of three motor carriers into the air freight forwarding business. The Board concluded that no precedent or policy barred entry of surface carriers into the air freight forwarding area, and that its policy should be one of "granting authorizations which will contribute to the growth and development of air cargo, rather than one of protecting existing forwarders from competition."¹⁹ The Board went on, somewhat cautiously, to conclude that "the rule will not be free entry, but monitored entry."

The Southern Pacific Case extends the monitored entry policy to railroads, and sets up several decisional criteria for the granting of freight forwarder entry. These are:

- The demonstration that granting the application will result in substantial benefits;

18. *Air-Truck Coordination and Competition*, Interstate Commerce Commission, Bureau of Economics, Statement No. 67-1; (1967).

19. *Motor Carrier - Air Freight Forwarder Investigation*, Order 69-4-100, April 29, 1969, mimeo at pp. 3-4.

- The finding that the surface carrier will conscientiously promote and develop air freight and that there will not be any disabling conflict of interest between its surface operations and proposed air freight forwarding operations which will cause diversion from air to surface transportation;
- That effective competition within the existing independent air freight forwarding industry will not be reduced and that there will be no significant adverse competitive effect upon the independent air freight forwarders; and
- The determination that the surface carrier applicant is capable of performing the proposed air freight forwarding operations and of conforming to the provisions of the Act and the rules, regulations and requirements of the Board thereunder.²⁰

Similar standards could be applied to considerations of direct combination of a surface carrier and an airline for integrated transportation firm operations. The Interstate Commerce Commission permits several combinations of multi-modal ownership by the same corporation — as, for example, the Southern Pacific's operation of trucking and pipeline subsidiaries in addition to its basic railroad operations. However, the accomplishment of a complete multi-modal transportation company has yet to be achieved.

Liberalization of the Board's outlook on the common control and operation of air-surface services is shown by the expanding mission of Air Cargo, Inc., a company, entirely owned by air carriers, which engages in truck services. Air Cargo, Inc. was incorporated in 1941 by a group of major airlines, with an initial goal of determining what future existed for the air freight industry. Over the years its functions and responsibilities have broadened into other areas. It has constructed and now manages a trucking network that covers the continent; it builds cargo terminal facilities; acts as joint counsel and representative of the airlines in the surface transportation field; administers a nationwide insurance and cargo claims service; cooperates with federal, state and local regulatory agencies; conducts joint purchasing programs; and, perhaps most significantly, saves the airlines many of the problems of providing ground support systems to back up their growing air freight business.

The first Air Cargo, Inc. pick-up and delivery contract was executed in 1947, and the corporation estimates that it now handles 44 percent of domestic air

20. *Southern Pacific-Santa Fe Air Freight Forwarder Case*, Dockets 18776 and 19164, September 22, 1970, mimeo at p. 75.

freight movements. Since 1947 the company has experienced dynamic growth of corporate activities; it is now the official cartage service of the scheduled airlines and has almost 500 local pick-up and delivery stations serving approximately 7,000 points through 432 airport cities across the nation.

With the continued growth of air freight traffic, Air Cargo, Inc. initiated in 1961 its present Air/Truck service. By 1965 more than 150 line-haul motor carriers had transported more than 700,000 air freight connecting shipments that grossed \$4,400,000, servicing more than 3,300 points not otherwise reached by air. The initiation of the Air/Truck service was made possible by the amendment of Section 1003(b) of the Civil Aeronautics Act. This removed the requirement that the establishment of through service must always be accompanied by the mandatory establishment of through rates, subject to review by joint Boards composed of both Civil Aeronautics Board and Interstate Commerce Commission members.

Each motor carrier acting under the Air/Truck system is able to establish through service arrangements by becoming a party to a standard form of Interline Agreement executed through Air Cargo, Inc. It establishes the basis for the exchange of traffic in through service, the methods for all documentation, the assessment and collection of charges, the handling of C.O.D.'s and the like. Air Cargo, Inc. also provides a "substitute service," namely the partial substitution of motor freight for air freight as the occasion warrants; e.g., Providence/Boston; Stockton/San Francisco.

It has been urged that the full economic benefits of true inter-modal services cannot be realized unless there is common ownership of the several modes. It is pointed out, for instance, that the coordination of scheduling involving two separately owned and operated transportation companies is inevitably a compromise; the best schedule for the transportation of traffic flows between the two companies is a secondary consideration to the best scheduling of the primary traffic flows entirely within each company.

The technology of inter-modal transfer facilities and multi-modal equipment also suffers from the absence of common ownership. There is little incentive for carriers to undertake or finance research and development directed toward the creation of technological opportunities in the field of multi-modal transportation when separate ownership permits only a partial participation in the benefits of such opportunities.

Thus, legislative and regulatory policies, which limit inter-modal operations, produce both inefficiencies and high economic costs. These result from the less-than-optimum allocation of resources and lost economic opportunities that

occur when investment decisions are made with the separate interests of individual modal, rather than multi-modal, transportation companies in mind.

6. REGULATION OF SUBSIDY

The Civil Aeronautics Act of 1938 was enacted at a time when it was evident that air transport services could not achieve self-support and that a form of government assistance was necessary if the fledgling industry was to survive and develop. Thus, Section 406(b) of the Act provides that the Board, in establishing rates of compensation to air carriers for the transportation of air mail, should take into consideration the need of each air carrier for such compensation, together with other revenues of the carrier, as would enable the air carrier "under honest, economical, and efficient management, to maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service, and the national defense."

In the early period of regulation, all of the basic air transport services required and received government assistance in the form of mail subsidy. The subsidy bill was a prime, if not the single most important, concern of the Board and its staff. Much of the energies and resources of the regulators were devoted to the intensive scrutiny of subsidy claims, and the development of regulatory policies to reduce the need of the industry for subsidy support.

As the industry gained in size and strength, more and more carriers were found to be economically self-supporting, without direct subsidy support. The first entire segment of the industry determined by the Board to no longer require subsidy support were the international truckline carriers, in the fiscal year ended June 30, 1958. U.S. domestic carriers were next found to have achieved full self-sufficiency and no longer require subsidization in the fiscal year ended June 30, 1959. Subsidy was also wholly eliminated for helicopter carriers in the fiscal year ended June 30, 1966. However, this segment of the industry was not found to have achieved self-sufficiency. Rather, it was decided that the limited public benefit derived from helicopter services did not justify the large amount of subsidy support required to cover operating needs and provide a fair and reasonable return on investment. Today, only regional air carriers, including carriers operating within Alaska and Hawaii, are subsidized. A recapitulation of annual subsidy payments to each of the principal categories of air carriers is shown in Table III-2 below.

The Board has interpreted the Act to empower it to withhold subsidy from individual carriers and from classes of carriers. It is generally agreed in the industry that truckline carriers can and would be denied further subsidy eligibility by administrative discretion of the Board, even though substantial segments of the

TABLE III-2

ESTIMATED SUBSIDY ACCRUING – BY CARRIER GROUPS FISCAL YEARS 1954–1970
(In Thousands)

<u>Fiscal Year</u>	<u>Alaskan</u>	<u>Hawaiian</u>	<u>Helicopter</u>	<u>International</u>	<u>Local Service</u>	<u>Trunkline¹</u>	<u>Grand Total</u>
1954	\$8,303	\$ 689	\$2,574	\$18,714	\$24,299	\$3,822	\$58,401
1955	7,902	293	2,656	3,757	22,358	2,773	39,739
1956	7,619	291	2,735	6,632	24,122	1,790	43,189
1957	7,707	216	3,771	6,903	28,444	1,572	48,613
1958	8,179	45	4,419	4,911	32,703	2,283	52,540
1959	7,337	168	4,860	—	36,450	1,201	50,016
1960	8,670	330	4,930	—	51,498	—	65,428
1961	9,256	505	5,538	—	56,299	—	71,598
1962	9,055	338	5,781	—	64,731	—	79,905
1963	9,689	520	5,000	—	67,511	—	82,720
1964	9,411	802	4,300	—	65,270	2,566	82,349
1965	8,162	995	3,358	—	62,862	3,475	78,852
1966	6,508	1,124	1,170	—	58,079	3,089	69,970
1967	5,938	567	—	—	54,373	2,477	63,355
1968	5,895	—	—	—	47,986	1,343	55,224
1969	5,469	—	—	—	40,643	—	46,112
1970	4,917	—	—	—	36,000	—	40,917

1. Trunkline accruals for 1964 through 1968 reflect local service operations in New England area.

Source: CAB, *Subsidy for United States Certificated Air Carriers*, November 1969.

truckline carriers might incur operating losses over extended periods of time. All-cargo carriers are wholly excluded by the Board from subsidy eligibility, although these carriers are authorized to carry both surface mail and air mail. Supplemental air carriers and air taxi carriers are also denied subsidy eligibility. Trans-Caribbean Airlines has been denied subsidy eligibility since its initial certification for scheduled services. Helicopter carriers also have been denied subsidy eligibility under the Board's interpretation of its powers. However, this occurred after Congress had manifested its displeasure with the subsidization of helicopter services.

The early administration of the subsidy program was not designed to encourage innovative and speculative management practices. For the most part, subsidy compensation was determined after the fact, to compensate the air carriers for operations already performed. Experienced revenue and costs were screened critically to ascertain whether the standards of honesty, economy, and efficiency of management had been met in operations producing the subsidy need requirements. Excessive costs or revenue losses resulting from ill-fated adventures of management were disallowed on the basis of hind-sight judgments formed, in part, from a review of the experience of other carriers that had not similarly engaged in the unsuccessful management practices. On the other hand, carriers were held to account for the same degree of prescience exhibited by carriers whose management actions had produced lower unit costs or higher revenues. Subsidy compensation of carriers whose management actions produced a more beneficial balance between operating revenues and operating costs was reduced in direct relation to decreased subsidy need. Thus, in effect, the subsidy compensation system, as initially applied, penalized the carriers for unsuccessful management judgments, while claiming in full, for the taxpayer, the fruits of successful management judgments.

Incentive formulas for mail pay compensation, affording the carriers a share of the net benefits achieved by successful management initiative, have gradually and now fully replaced the early system of determining subsidy compensation. But, the full rewards of a successful gamble are not completely available to subsidized carriers, even today. While the balances of penalties and rewards have changed, it is still the case that a subsidized carrier has more to lose than to gain by a speculative departure from the customary or accepted in management policies and actions.

Thus, while subsidization has given some strength and stability to a group of air carriers that otherwise would constitute a meager market for any new technology, the regulation of subsidy payments does not encourage innovation by the carriers receiving subsidy. The fact that the local service carriers, which today have the heaviest dependence on subsidy among U.S. carriers, are the principal suppliers of short-haul air services affords a further explanation of the lag in short-haul air transport technology.

7. REGULATORY OVERSIGHT OF MANAGEMENT

The CAB has extremely broad powers of oversight into every aspect of carrier management under Titles IV and X of the Act. Section 415 empowers the Board “to inquire into the management of the business of any air carrier and, to the extent reasonably necessary for any such inquiry, to obtain from such carrier, and from any person controlling or controlled by, or under common control with, such air carrier, full and complete reports and other information.” Section 407 of the Act further empowers the Board “to require annual, monthly, periodical and special reports from any air carrier; to prescribe the manner and form in which such reports shall be made; and to require from any air carrier specific answers to all questions upon which the [Board] may deem information to be necessary.” The Board also has the authority, under its general powers and under Title X to require full and detailed information with respect to any and all facets of air carrier operations and management.

The Board is thrust squarely in the middle of traditional management areas with its control over markets that the firms may serve – route making authority – and prices at which they shall offer their services – rate-making power. Section 401(d)(1) provides that routes may be authorized by the Board upon the finding that an applicant is “fit, willing, and able” to provide the transportation service properly and that the public convenience and necessity require such service. The discretionary power of the Board is extremely broad, with a notable exception of a limitation under Sec. 401(e)(4) providing that “[n]o term, condition or limitation of a certificate shall restrict the right of an air carrier to add or change schedules, equipment, accommodations, and facilities for performing the authorized transportation . . .”

The ratemaking powers of the Board are enumerated under Section 1002(e) that prescribe as the Rule of Ratemaking that the Board shall take into consideration, among other things, the “need of each air carrier for revenue sufficient to enable such air carrier, under honest, economical and efficient management, to provide adequate and efficient air carrier service.” A parallel instruction under Section 406(b) directs the Board to consider carrier need, under honest, economic and efficient management in connection with the Board’s authority to determine rates applicable to the transportation of the mail.

The result of such detailed oversight is that all phases of carrier operations are reported to the Board, and the operating and financial affairs of each carrier are matters of public record. There are thus few secrets that one carrier can keep from another that would give it special advantage over its competitors in the same sense that patents, copyrights and other trade secrets operate in the unregulated sector of business.

Stripped of the traditional management prerogatives of unilateral determination of prices, markets and a wholly independent search for competitive advantage, the carriers thus have limited incentives to make innovation a prime managerial concern. Developmental benefits under economical and efficient management tend to be short-lived, since the successful ones can be readily seen and copied by competitors. Technical experimentation that would result in cost savings is not necessarily rewarded by increased earnings, since the benefits of such measures may be deemed to reduce the revenue "need" of a carrier. That is, by interpreting the revenue requirements of the carrier industry to be an overall return on the investment base, efficient methods of operating promulgated by one carrier may only serve to reduce the investment base, and hence, reduce the total revenues needed to achieve a satisfactory return on that base.

The astringent interpretation of the regulatory mandate tends to punish management error, but does not offer corresponding rewards to successfully implemented change. The net effect is to dampen innovation, and by indirection to set up organizational stolidity as an acceptable condition. An example of this problem is illustrated in the initial decision of the examiner in the Northeast Corridor VTOL Investigation. The examiner notes that:

"all of the civic parties, aircraft manufacturers and air carriers that filed briefs and every expert witness agreed that there is a pressing need to alleviate these delays, frustrations, and losses caused by air travel congestion. Practically all conclude that metroflight²¹ is the most appropriate means of doing so. Only the [CAB] Bureau of Operating Rights (BOR) disagrees, saying that (1) further surveys of traffic potential must be made, (2) the cities must decide where the landing sites will be located, and (3) the manufacturers must determine the exact seating capacity, price and delivery date of the STOL or VTOL aircraft, before either the question of need for or that of the feasibility of metroflight service can be determined."²²

The examiner goes on to relate how the BOR, joined by Eastern Airlines continued to seek delay for the purpose of making a survey "to supplement a somewhat similar survey . . . undertaken by DOT, covering about half of the markets in question."²³ The examiner concluded that the delay was not justifiable. Eastern further argued that "it will have to know the sites actually selected by the cities and the exact price and capacity of the available STOL or VTOL equipment before a decision as to feasibility can be reached."

21. Metroflight service is defined as air transportation to be provided by common carriers using STOL, VTOL and/or V/STOL aircraft.

22. *Northeast Corridor VTOL Investigation*, Docket 19078, mimeo pp. 14-15.

23. *Ibid.*

Plainly, the regulators are not monolithic entities conspiring to retard innovation; but the regulatory process into which all parties are commonly bound undeniably takes its toll on the emphasis that research and development receives, and on the rapidity with which innovation can be effected. In an attempt to look to future needs as part of its duties, the Board needs assistance from the industry and from its own staff.

8. REGULATORY CONSTRAINTS ON NEW TECHNOLOGY

The regulation of the air transport industry has not been oriented to the encouragement of technological innovation, except to the limited extent that authorized competition spurs reequipment. The requirements for approval by the Board of proposals to amend or modify the system of authorized air services results in rigidities in the structure of such services which inhibit air carriers from adapting new technology to the developing and changing needs of the market, and which also inhibit air carriers from adapting air services to the developing capabilities of new technology. While the necessary changes in authorized services can be obtained, the regulatory process imposes long delays and lags before the requests for new services are docketed, tried, and decided.

Rate regulation creates further rigidities, requiring protracted delays and usually loss of earnings while proposed rates are litigated before the Board. These rigidities, moreover, are reinforced by regulatory policies which require that the carriers bear the risks of new technology, while providing the carriers with no protection of earnings if new technological ventures are successful.

Regulation of subsidy and the Board's continuing surveillance of management further discourage innovation within the industry. Subsidy regulation has been applied in a manner which seriously penalizes errors in the selection of new technology; the spotlight on every facet of airline operations and management severely limits the opportunities for the extended enjoyment of the fruits of a successful selection of technology.

- *Short-haul Services*

Although there is widespread recognition of the need for improved short-haul air services, the air transport industry has failed to acquire and implement new technology which would arrest a steady deterioration in the quality of services available to the short-haul air traveler. This failure to meet an acknowledged need can be laid, in part, to the lack of appropriate economic incentives and opportunities, under past and present regulatory policies, to create a viable market for new and improved short-haul technology.

One principal inhibition is the lack of profit opportunities under prevailing rates. The costs of short-haul operations characteristically have exceeded the prices charged for short-haul air services. It has been traditional to subsidize short-haul air services either from excess earnings extracted from longer-haul air travelers, or more directly through subsidy mail compensation. For the carrier with lucrative long-haul services, the investment in short-haul technology is like throwing good money after bad. For the carrier without long-haul services, the resources to acquire new technology are not available. Moreover, even if the resources were available, risks of a poor selection are intolerable.

Another inhibition is that short-haul air services are fragmented among such a multiplicity of different carriers that some carriers are unable to acquire and effectively use fleets of minimum economic sizes. The structure of the market for new technology, because of the way authority is allocated among operating entities under prevailing regulatory policies, constitutes a serious constraint on the purchasing power of the industry.

- *Multi-modal Operations*

A further inhibition on technology, that cuts across several modes, is the failure of the Board to encourage multi-modal combinations. In the process of assuring that the air carrier industry focus its efforts on a single-minded goal, the Board has in the past allowed some opportunities for the logical extension of aviation to go by. It is technology that has suffered as much as anything else, as potential developments in the interface between modes have not occurred.

For a major segment of the industry, air cargo is considered and treated as a by-product of air passenger services. For a smaller segment of the industry, exclusive air cargo service development is important in its own right, but this segment of the industry is neither sufficiently large in scope nor sufficiently endowed in resources to constitute a viable market for new technology. As a result, the conception and implementation of new and improved systems of collection, distribution, ground handling, and transportation of air cargo has lagged. At one end of the spectrum, there has been no consistent and material progress made in adapting air cargo technology to the needs for economical and efficient air services of large volume shippers. At the other end of the spectrum, the solution of technological problems in the movement of small shipments also has lagged. Since the inception of air cargo services, the expectation of a major breakthrough has been predicted. But, this expectation has not been realized despite a steady growth of air cargo. The great bulk of the market foreseen remains untapped and the regulatory system must shoulder much of the blame for this failure because it has not provided a regulatory environment which encourages and affords the means to undertake technological innovation.

AIRPORT SITING AND DEVELOPMENT

Institutional constraints on airport development are discussed in this section. Since airport siting is reciprocally related to access, the issues and problems associated with improved access systems are also discussed. ATC, though linked to airport development, is discussed elsewhere in the report.¹ The cutting edge of ATC R&D will essentially increase CTOL capacity and/or enable V/STOL systems to be implemented; ATC R&D will not directly brush up against *landside* airport constraints, the subject of this chapter. Included, however, is an analysis of the effects of current legislation and administrative practices on airport landside development. This analysis converges on the question of the role of the airport from aviation systems and regional development standpoints. Finally, options are outlined that could accelerate progress and perhaps break the paralytic bind in which airports and related landside subsystems currently find themselves, in so many urban areas.

1. IMPLICATIONS OF FOOTDRAGGING ON AIRPORT DEVELOPMENT

The nation's airport network spans over 11,000 landing facilities of which 817 provide certificated airline service. Also, about 12 sizable airports handle general aviation exclusively. Though the last decade has witnessed unparalleled growth in both operations and enplanements, few major airports have been conceived, planned, and built during those years. This paradox is emphasized by the present saturation of the Kennedy, Newark, Washington National, LaGuardia and O'Hare airports operating under FAA-imposed quota on peak-hour plane movements.² Because projections continue to call for a disproportionate number of enplanements at a relatively small number of airport hubs, growth in the nation's total aviation capacity may be dampened by metropolitan airport foot-dragging.

One may anticipate two undesirable effects of being unable to respond to growth and upgrade the aviation systems airport capacity. First, the national economy will be adversely affected by the impeded flow of managers and technicians who, as a group, exert high leverage in industrial and scientific activities. Second, and for purposes of this study more importantly, failure to build airports will directly affect both the development and implementation of aviation technology. Airport lead times are so long (5-10 years from plans to

1. See section entitled "Subject Area Reports."

2. Almost 70 percent of passengers enplaned on scheduled carriers use the facilities of 35 airports serving the 22 large hub communities.

operating reality) that eccentric delivery of this component of the aviation system easily upsets the R&D cycle for the other subsystem components, most of which enjoy shorter developmental lead times. For example, new airframes can be developed in 3 years. Thus, the resolution of questions concerning feasibility of airport types and designs (given the likely airside technology of the rest of the century) will provide industry with considerable guidance concerning the appropriate R&D effort which should be placed behind such development projects as STOL, VTOL, or V/STOL. Likewise, government may more safely support demonstration projects knowing that they are: (1) politically feasible, and (2) likely to trigger more producer and consumer interest. In short, the stakes here are of paramount importance; if airport development is effectively stopped by either political indecision, or a failure to understand which types of airport configurations are acceptable to people directly affected, the economy in general and the aviation industry in particular will be the worse for it.

2. THE SCOPE OF THE LANDSIDE PROBLEMS

Airports play a variety of roles, which constitute both a strength and weakness. Airports are the key interface between the aviation system and the rest of the national transportation network. Moreover, being a critical part of that network, airports assume strategic developmental importance; without air travel a region cannot easily grow and prosper. Further, within an urban region airports *may* constitute an important collection point for trips to the CBD and contribute to the urban transportation problem.³ Airports also provide a focal point for generating both transportation system benefits and costs. While the entire region may ultimately reap transportation benefits, the sound and the smell of air progress inconveniently descends on the airport neighborhood. As a result, the airport's voting neighbors think the airport is a "bad" neighbor. Thus, the mix of roles and multiple dimensions of airport presence and development have resulted in an assortment of laws dealing with issues ranging from urban development to environmental protection. The ultimate result is that airport development is pushed and buffeted in several directions by various political forces. (This will be expanded below.)

The airport operators, therefore, are confronted with landside problems that are frequently beyond their ability to control. These problems are also not particularly subject to solution through technological innovation, though some

3. Fortunately the impact of airports on hub-bound peak hour traffic is still small. Nightmares like the Van Wyck Expressway snarl at Kennedy are rare. Nonetheless, this situation bears watching elsewhere. For a comprehensive treatment of the subject, refer to *Transportation Engineering Journal*, Proceedings of the American Society of Civil Engineers, No. TE1, February 1969, pp. 6415.

might well be attenuated by imaginative airside research.⁴ Consequently, airport operators individually and collectively sponsor too little landside research. Airport operators perceive their problems in terms of urban development, public taste, and political maneuvering. Their research concern, if they can mobilize it, tends to focus on the implementation of additional runways, and other relatively politically inoffensive airside developments.⁵ Nonetheless, pedestrian circulation, terminal design, baggage handling, and ground access do constitute perceived, nonpolitical, landside, and technical problems that appear too costly or complex for the myriad of airport operators to cope with. For this, some of the larger, more successful operators may be faulted. It is necessary, then, to determine the key issues and constraints for airport development.

3. SOME LANDSIDE PROBLEMS

a. Airport Development

Where do we put the next large regional airport? Curiously, most people seem to be still in favor of aviation progress, and perhaps even a majority of people within a region would like to see airport needs met — but not in their neighborhood. (George Washington University has comprehensively described the impact of airport development in another report to the CARD study.) Needless to say, airports, CTOL or STOL, are cumbersome projects to site within a region. First, they require a great deal of space — 23,000 acres in the case of Palmdale Intercontinental Airport. Siting constraints must be considered in terms of key attitudinal factors that lie beneath current objections to airport siting and expansion.

Attitudinal factors relate to a mood created by group inclination to view tomorrow's problems with the unaltered knowledge or practices of the past. However, attitudes are also ultimately harnessed to fundamental philosophical, political, and economic issues. Many of these issues are so bonded to values that they may not be regarded as constraints directly amenable to remedial policy. Thus, for example, the demonstrated desire on the part of most Americans to subscribe to the precepts of the American free enterprise system may not be

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4. For example, airport operators have sponsored little research into exploring innovative ways of planning runways (e.g., with joint CTOL-STOL use) or otherwise expanding the capacity of airports through physical design experimentation.
 5. Airport operators tended to remain a mute system component even before airport siting became such a burning issue with minority groups, aroused local residents and assorted politicians. However, in the old days, airport operators bent to the requirements of the equipment manufacturers and the carriers. What is different now, of course, is the direction of the development signals; they are being beamed in by the polity instead.

identified as a constraint which should be manipulated or sacrificed to produce more airports. Nor should policy attempt to increase the polity's threshold for tolerating obnoxious environmental side effects of aviation activity simply because attitudes toward noise constrain airport development.

The key constraints on airports are generally (1) environmental, (2) behavioral, and (3) political. Convenience rather than conceptual purity characterizes these classifications; some attitudinal constraints easily bridge two, or even three, of these categories. *Environmental* constraints consist of those pertaining to the degradation of the environment and include attitudes toward clean air, noise and similar items. *Behavioral* constraints arise from public attitudes toward safety, convenience, reliability and land use, and public agency attitudes toward putative goals. *Political* constraints include such dispositions as those relating to the preservation of American economic hegemony and "home rule."

1. Environmental Constraints

Environmental factors have become increasingly important. Man's threshold for tolerating perceived environmental degradation has been reached in the minds of a large and increasingly vocal segment of our population. Noisier and more frequent plane movements have made aviation unpopular in many cities and their suburban residential areas. VTOL, for instance, received a major setback when clamor against noise from the Pan American rooftop operation became a major factor in the discontinuance of flights from that unique location.⁶ This Pan Am experience has served to both dampen enthusiasm of VTOL proponents in Manhattan and energize citizen-based action against V/STOL facilities in general. Because New York City is pivotal for so much of the passenger traffic in the Northeast Corridor, failure to win a functioning and accessible Manhattan CBD operation has cast a severe pall of uncertainty over the entire V/STOL market. The problem of V/STOL center-city siting was once considered to be primarily one of high cost. Today, however, it is widely perceived to be infeasible on political grounds, largely as the result of the New York experience.

Noise and anticipated air pollution also have stymied efforts to increase CTOL airport capacity. Concern with esthetics, conservation, and compatible land uses has crippled runway expansions at existing airports (e.g., Logan, Kennedy and San Francisco), and has effectively blocked efforts to find sites for new ones. Much of the controversy surrounding the development of the celebrated SST has been generated by the environmentalists who are concerned with several problems, including the noise created at take-off and landing.

6. Considerations of public safety were also important in this case and were partially instrumental in halting the rooftop operation.

If, indeed, the country is more sensitive to airport siting problems, it is not unlikely that CTOL (or even STOL airports under some circumstances) will be sited farther and farther away from the centroid of urban population. This development can and does bring airport proponents in conflict with open space advocates, not only because airports in themselves consume vast acreage (18,000 acres in the case of Dallas-Ft. Worth), but also because they attract substantial satellite activities ranging from goods-handling to service industries which, when established, bring further residential growth. It is not unlikely, therefore, that the problem of airport access will become critical; the fate of city-center to airport traffic appears dismal unless the trip can be shortened between these two large collection points.

Moreover, airports and aviation activity are not widely regarded as being "good neighbors" in most urban situations. Some see aviation technology conferring benefits directly on the few. Others, who recognize the contribution of aviation to the local economy but who are unwilling to lead community opinion, have adopted an expedient game of airport siting in which no one can win, by saying, "Don't put it here."

2. Behavioral Constraints

A major behavioral problem is passenger peaking. Diurnal work patterns are largely confined to the period extending from 7 a.m. to 6 p.m. As a result, there are peak hour demands for services to get to work and to return home. The existing transportation network strains to meet this demand and does so only at the price of operating costlly, capital-intensive systems at low average loadings. The immediate significance of this pattern is that it results in less than optimum use of airline and airport facilities, thereby lowering system profitability. Furthermore, the need for air passengers to use highways clogged by commuter traffic may significantly affect the accessibility to airports and local destinations simultaneously. Airport access is discussed in detail below.

Another problem is the tendency of established bureaucracies to replace community goals with their own. Thus, for example, each modal administration sees the transportation problem in terms of the parochial difficulties of its own mode, and jealously hoards the funds it has fought for in previous years against the aims of "rival" modes. Also, a major transportation agency in a large hub concludes that it is more prudent to invest capital in profitable real estate developments than to "risk" making that capital available to improve the access and usefulness of an airport which it operates in the interests of the entire community.

3. Political Constraints

The “chicken and egg” problem of the aviation industry in general, and airport operators in particular, is closely linked with the inability of government at all levels to articulate transportation goals. The problem is particularly important in the case of civil aviation R&D because the industry has traditionally received funding and priorities from the public sector. Even where the private sector is involved, government regulations may significantly alter the signals which consumers send to manufacturers via the airlines and airport operators. Hence, abdication of responsibility and political maneuvering by government have severe repercussions on the industry.

The problem of goal articulation is staggering when viewed in terms of our country’s federal system with its overlapping and fragmented governmental jurisdiction; this consideration is outlined below in more detail. Air transportation is of both national and local concern. Airports are located at the focal points of the system, and their impact may be called regional; yet our overall government structure cannot easily reconcile national and regional concerns with those of localities. No one really speaks for a region, since regions are seldom political entities with identifiable constituencies. Then the question of what constitutes a region raises a debatable issue; it is no wonder that airport siting decisions consist of endless buck-passing and delays. The fourth New York Jetport is no more resolved now than five years ago. One also strains to imagine how, when, and where airport system capacity will be expanded in Boston or Chicago. The experience of the large urban hubs may be particularly frustrating (some may hold it to be unrepresentative of the public), but there can be little doubt, given the forecasts of air travel demand of the ’80’s and ’90’s, that these problems will be extended elsewhere.

A major factor behind the whole sphere of political constraints is that many people view air travel as an essentially elitist transport mode. Air transportation has been growing rapidly – nevertheless, only 22% of adult Americans flew in a plane last year and only 10% flew more than three times.⁷ What is perhaps most distressing from the political viewpoint is that often the people who did fly belonged to a high socioeconomic class. Not only does the air passenger have an income 2.5 times higher than that of the “average American,” but about a quarter of the passengers had incomes in excess of \$25,000.⁸ The case of building political support for costly, uncomfortable airports under these circumstances is unquestionably difficult, no matter how vocal aviation interests may be in

7. Gallup Organization, Passenger Travel Data, June 1970.

8. Alan J. Munds, *Ground Access to Major Airports in the United States*, M.I.T. Department of Aeronautics and Astronautics (January 1969, p. 13).

informing the general public about the “indirect” economic benefits of airport activity. In the end, the average voter has little air travel experience; attempts to impress him with the priority of air travel by means of abstract concepts will probably have marginal effects at best. Therefore, the distributional problem of government expenditures coupled with other seemingly higher priority programs tends to make official goal articulation politically difficult. This problem haunts a variety of aviation subsystems, including airport access.

b. Airport Access

While the *need* for improved airport access is apparent to passengers and the industry, system requirements have not been translated into *effective demand*. There is no one at present who can sustain sufficient expenditure levels to assure a market for access systems. State and local governments appear hesitant to proceed without adequate demonstration of feasibility. Industry is doubtful that state and local government will invest, even with demonstrations, because of (1) historic unprofitability of transit, (2) competing claims for system improvement by resident-voter-straphangers, and (3) urgency of other obvious urban problems, such as housing. The frustration of being unable to assess the market for ground access service led one technician we interviewed to plead that “the federal government ought to do meaningful research in how to get people out of cars.” In light of the present settlement trend toward low density suburbanization, this plea is wishful thinking.

The airport access problem is perceived by some as being fundamentally one of the future. Many city policy-makers feel travel delays and congestion are limited to a few very large, densely populated urban areas — New York, Chicago, Los Angeles, etc. — so they are reluctant to anticipate growth implications. The need for specific systems is also unclear. Costly, fixed-right-of-way systems appear inappropriate in many areas, due to combinations of low density settlement patterns and positive attitudes toward automobile usage. The definition of the market itself contributed to the problem, particularly for industry. Is the airport access “market” one to which traditional producers of equipment can respond? Is it one on which aerospace and systems technology firms have a claim? Is it mainly a big, costly construction job involving comparatively small investments in equipment R&D? Or, are there several submarkets for line haul systems, systems to distribute people within the airport, and baggage handling systems? One observer claims that the problem is not a need for new technology R&D, at least in the line haul area: “The process of searching for a panacea, such as a linear induction motor, tracked air cushion vehicle (LIM-TACV) is holding us back from making a decision on which system to build.” This sentiment shows user confusion over whether to push for current technology-based projects or wait for new technology.

Collectively these problems frustrate the private and public sectors. They expose private industry to heavy risk but do not offer profit opportunities commensurate with that risk. They prevent mobilization of the public sector decision makers; it is extremely difficult for these officials to justify expenditures for systems that exist only as concepts or that may be technologically obsolete as soon as they are built.

c. Computer Ticketing, Automated Passenger Movement, and
Baggage Handling Technology

The technical problem of implementing a system to deliver passengers and baggage directly, quickly and dependably from downtown to planeside, alongside existing multimodal systems is perceived by some as being more complex than any other transportation problem yet tackled. As a result, no people-mover system now being developed met the specifications set down by the Port of New York Authority for internal distribution at Kennedy. The unreliability of technology, described by one officer as a "wasteland of technology" thus retards planning which could accelerate the speed and convenience of air travel, and reduces the probability of cooperative agreements among airlines, airports, and transportation agencies. Such cooperation, in regard to innovative ticket pricing policies, would equitably allocate the costs of developing high speed access among all beneficiaries and participants. The problem here vividly underscores the "chicken vs. egg" conundrum which characterizes the present impasse in access. Modern terminal pedestrian circulation problems alone constitute sufficient need for research. Nonetheless, this problem, like most of the others discussed in this section, falls "between the slats" of many agencies which are interested in providing part of the total door-to-door transportation service.

d. Discontinuities at Modal Interfaces

The traveler encounters many inconvenient "gaps" in services as he travels the route from CBD to airport gate. These gaps result in delays which tend to alienate him. The transfer from one mode to another and the trip across or through an interface such as an airport terminal are perceived as being unfortunate, and to some degree the result of the Civil Aeronautics Act which generally forbade the acquisition of control of an air carrier by a surface carrier. The CAB has interpreted the law to require intermodal competition. Some feel that if the law would be construed more liberally, passenger convenience *might* be greater than it is today.

The essential problem, then, is the difficulty in planning for CBD-to-CBD routing and ticketing because there are so many transportation franchises that are attempting to maximize their own profits with little regard for the inconvenience which the traveler encounters upon exiting from a franchised system. Hence,

terminals may be designed to facilitate enplanements and reduce turnaround times, but not to facilitate pedestrian flows. Airport access systems often end in parking lots requiring long, tedious walks for travelers. The air transport system, the terminal pedestrian circulation system, the parking system, the limousine and bus system, the transit system, and even the downtown terminal system are all run *as if* they are singular and unrelated.

4. STATE AND LOCAL GOVERNMENTAL RESPONSE TO THE LANDSIDE CHALLENGE

a. Pseudo-Governments

Conventionally, where the private sector is confronted with many social problems, and where third-party effects abound, the government steps in and fills the vacuum. Let us examine governmental involvement in the airport problem and determine the pattern of its response. First of all, virtually all certificated airports are operated by either pseudo-governments (i.e., government-created independent authorities which may finance airport activities through revenue bonds) or by agencies of local general governments. In the former case airport revenues and governmental subventions amortize the substantial debt involved and cover operating costs. In the latter, some combination of grants, revenues, and appropriations from the communities' general fund keep the operation in the black. In practice, despite these financial ties to local government, airport operators behave *as if they were private operators*. That is, they are frequently well insulated from federal, state, and local government interference except within certain prescribed areas, i.e., the FAA dictates operational rules, and state and local governments restrict the geographic scope of airport activity and the general terms under which they may charge for services and raise capital. Their insulation permits them to channel funds into projects that are especially remunerative and satisfying for the operators, mortgagees, and bondholders. These projects may have little to do with improvements or research into the landside subsystem. This may be why, for instance, that one authority has gone into the lucrative real estate business but has made no successful attempt to solve its ground access problem. Such authorities pose special problems. Part of their freedom is attributable to their insulation from general government and the voters. But their incapacity to aggressively deal with problems like airport siting and access may also stem from this same insulation. Under such a mandate, the public interest suffers.

b. Governmental Fragmentation and the Decision-Making Locus

The proliferation of local governmental bodies within a metropolitan area is a sizable institutional constraint on airport siting and access in particular. During the 1950's it was believed that consolidation, confederation, and metropolitanization of an urban region could produce a tier of government which, if not a

general-purpose government, would at least be a special district with wide geographic scope. Challenged by representatives of very diverse political persuasions, consolidation and metropolitan government floundered during the 1960's. Some saw efforts at consolidation as a plot to eliminate their right to home rule. Others charged that local control was absolutely necessary for a participatory democracy. Left largely on the starting blocks were those who saw airport congestion problems growing, and an increasing disparity between the needs and the authority and ability to meet them on a comprehensive basis. The difficulty of reconciling basic attitudes toward local government with needs originating from an entire region is a major reason for the present impasse.

This impasse may be seen most clearly in the case of airport siting within a large urban region. Historically, land use determinations were made at the local level. The greater the number of local planning bodies and commissions, the more difficult it becomes to assemble the vast acreage needed for major airports. Only by vetoing local objections or by finding some unifying issue can siting or access right-of-way acquisition proceed. The former policy involves changing the locus of land use determinations within the governmental structure. The latter requires "super issues" which galvanize support and mitigate opposition blocs.

Perhaps the primary factor constraining the development of improved airport access is fragmented government within an urban area and the resulting lack of coordination among the planning and action agencies within the fragments. Each governmental entity considers airport access from its own viewpoint. None consider it from a regional viewpoint. Thus, the residents of San Mateo County are less than enthusiastic about an extension of BART (Bay Area Rapid Transit) from Daly City to the San Francisco Airport (located in San Mateo). The interest of San Francisco in an SFO link on the other hand is heightened by the prospect of a BART link with Oakland Airport, a connection that could place SFO at a competitive disadvantage with Oakland as far as hub bound passengers are concerned. Hence, each locality tends to evaluate airport access in either competitive terms or from the standpoint of direct political impact – the number of resident air travelers.⁹

It is hardly surprising to find that the lead time involved in airport access approaches 20 years. First, the aviation industry had to become aware of the need. As one New York City official expressed it, "Up until recently, no one faced the problem of airport access. The airlines and airport operator took the position that access problems of the airport were someone else's concern." But unfortunately, it is relatively simple for a community to delay access planning.

9. Thus, a prominent national regional planner has expressed the need for "one, rational overall concept of airport and access development."

Politicians respond to strident local opposition — voter sympathy is biased against large, bulky, costly projects with selected clientele. One New York regional transportation executive states that, “Local footdragging set back our planning 18 months and necessitated coming in with state-enabling legislation at the ‘11th hour.’ With local opposition at the legislative level, we did not have a chance.” It is also difficult to generate support among politicians for projects that involve long lead times and which are not highly visible during the term of the incumbent. In short, a multiplicity of government jurisdictions insure multiple headaches for proponents of access.

c. Financing

Airports and related projects require massive capital outlays. And capital requirements are accelerating. The new Dallas-Ft. Worth Regional Airport calls for project capital costs of nearly \$450 million. Even STOL ports requiring modest facilities and runways may cost this much if a center city STOL strategy were to be implemented. Since most airports do not have revenues as great as those flowing to the metropolitan giants, it is difficult to market the necessary bonds unless a pledge of the communities’ credit is also forthcoming. The price tag on the MTA’s Kennedy rail access link alone may run as high as \$150 million. With public concern over increasing public expenditures, airport development becomes a high political risk venture with visible effects on a community’s fiscal capacity.

Even with the advent of the *Airport and Airway Development Act* with its 50-50 Federal grant-matching formula, the financial burden to communities will still be great since Federal monies cover only airside developments — and the landside costs may amount to about three-quarters of total project cost. (So Federal matching is really more like 12.5% Federal, 87.5% local.) However, non-hub airports may place much less emphasis on terminals and put about 20% of project funds in them. It is not surprising to find, therefore, that legislators and voters are closely scrutinizing landside proposals.

Recently, the New York State Assembly voted down the \$150-million Kennedy rail access project. In San Mateo, the West Bay Rapid Transit Authority’s bond issue was resoundingly defeated. By contrast, Cleveland had to put up only \$6 million to get two-thirds Federal funding from HUD because it was the pioneer access project, and the airport service was easily achieved as part of the expansion of an existing regional rapid transit system. The SFO and LAX projects now under study must soon meet the financial test. Without financial help they could fail.

5. AN OVERVIEW OF THE FEDERAL GOVERNMENT RESPONSE AND KEY CONSTRAINTS

Federal Government involvement in airport landside problems is a relatively new concern, though Federal funds have been granted for airports since the 20's on the basis of postal service needs, unemployment relief projects, and national defense. The Federal Government has also been influencing airport location since 1944 when it enacted the *Surplus Property Act of 1944* (P. L. 457, 78th Congress, 2nd Session), a law that enables communities to take over unneeded Air Force installations *gratis*, provided that they be used for aviation purposes. Even the well-known *Federal Aviation Act of 1946* (P. L. 377 - 79th Congress, 2nd Session), which resulted in a National Airport Plan and set the stage for subventions to county airports, did not really result in either the development of airport siting criteria, in laying its groundwork, or in paving the way for airport planning within the context of local comprehensive planning. On the contrary, the Federal Airport involvement has been essentially over air safety considerations.¹⁰ Landside considerations either in terms of *macro* (siting) or *micro* (facility) planning were conspicuously overlooked from the Federal viewpoint.¹¹ The Federal Government left the problem squarely on the shoulders of local government and the airport operators.¹²

10. According to its enabling statute, FAA jurisdiction over airport concerns extends only to the boundaries of the airport; the FAA may not, except in a consultative capacity, fund, develop, or even plan directly anything that takes place beyond the airport boundaries. Moreover, FAA jurisdiction extends only to airports which have received Federal construction and/or development money within the past 24 years, this represents only about 2200 of the nation's 10,470 landing facilities (of which 4200 are recognized airports). The only exceptions to this general constraint on FAA jurisdiction are with respect to safety and the use of air space.

11. HUD's 701 program did provide for airport planning for those communities having populations under 50,000.

12. The Airport's importance in the Federal system was recognized by the 1955 Commission on Inter-Governmental Relations, chaired by Meyer Kestenbaum, which made a special staff study of Federal aid to airports. The rationale for aid was both national defense and government's responsibility for promoting and regulating interstate and foreign commerce. The Kestenbaum commission study commented:

"These responsibilities, which have justified so much federal action with respect to various forms of land and water transportation, apply with special vigor to aviation. The fact that the characteristics of aircraft are so uniquely conducive to geographically wide spread rather than local operations serves to emphasize the federal interest, on interstate commerce grounds, in all aspects of aviation, including the airports upon which aviation is dependent."

The recent *Airport and Airway Development Act of 1970* (P. L. 91-258) essentially preserves the Federal Government's concern with air safety, though previous versions of the bill did contain mandates to fund internal pedestrian circulation projects and support development of the airport in terms of a total transportation systems package; complaints before Congress about inadequate ground transportation and terminal design went unanswered and with apparent impunity. (The significance of this law is discussed in greater detail below.) Meanwhile the recently observed indirect legal impacts on airports should be considered.

While Congress was skirting the airport development issue in the mainstream of airport and airways legislation, it was recognizing the complexities and importance of successful airport planning within the context of the urban and regional development legislation of the past five years.

The Demonstration Cities and Metropolitan Development Act of 1966 (P. L. 89-754) devoted Title II to planning and sought to coordinate Federal aid programs and improved state and local planning. Section 204 required that all applications for Federal funds, including those for airports, be submitted for full review by local and metropolitan planning agencies, such as Councils of Government [established by the *Housing Act of 1954*, Section 701 (g)] or area-wide transportation agencies (established under the *Federal Aid Highway Act of 1962*, Section 134). Moreover, Section 205 authorized the Secretary of HUD to make supplementary grants to state and local government agencies for metropolitan development projects, including airports being funded under the *Federal Airport Act of 1946*.¹³

Soon after, in the *HUD Act of 1968* (P. L. 90-448) Congress re-emphasized the need for cooperation among Federal agencies and coordination of planning at all government levels. Moreover, it devoted Title VI, Urban Planning, to a lengthy discussion of grants which emphasized comprehensiveness of planning. It also broadened Section 701 of the *Housing Act of 1954* to include transportation, and amended Sections 204 and 205 of the *Demonstration Cities Act of 1966* to encourage planning on an areawide basis rather than on a merely "metropolitan" basis.

Returning to the *Airport and Airway Development Act of 1970* (P. L. 91-258) one finds that Congress moved forward from the concepts underlying the Federal Airport Act of 1946. Thus, its purpose (Section 2) was to serve the needs of not only air commerce, but also "interstate commerce." It spelled out in considerable detail how to approach the complex task of both airports and airway

13. The eligibility of airports does not appear in the Act but in its legislative history in *House Report No. 1931*, of September 1, 1966.

systems planning. Section 3 charges the Secretary of Transportation with formulating and recommending to Congress a national transportation policy for approval. He is to consider, among other factors,

“(1) the coordinated development and improvement of *all* modes of transportation, together with the priority which shall be assigned to the development and improvement of *each* mode of transportation; and (2) the coordination of these recommendations with *all* other recommendations to the Congress for the development and improvement of our national transportation system.”

This Section is significant far beyond airports and aviation. For the first time, Congress required the design of a national transportation policy. Any such policy, to be worthy of the name and effort, must rest upon realistic assumptions about economic growth, its degree, and its direction. These assumptions are not self-evident and will not be made easily. However, to try designing a national policy will raise the questions and therefore open the door for considering airport siting and civil aviation in general as a useful tool for development.

Consistent with this major action on overall transportation policy, Section 12 directs the Secretary:

“to prepare and publish a national airport system plan. It shall set forth, for at least a 10-year period, the type and estimated cost of airport development considered. . . . necessary to provide a system of public airports adequate to anticipate and meet the needs of civil aeronautics Airport development identified by the plan shall not be limited to the requirements of any classes or categories of airports.”

Moreover, Section 12 (b) directs the Secretary to consider “the relationship of each airport to the rest of the transportation system in the particular area, to the forecasted technological developments in aeronautics, and to developments forecasted in other modes of city transportation.” Following subsections require extensive consultation with all governmental authorities (Federal, state and local) and various sectors of the public. As a whole, Section 12 suggests a new understanding on the part of Congress for the complex role which airports and airways must plan in the overall social, economic, and physical development of a region.

To conduct such a major effort, the Secretary is authorized by Section 13 to grant funds to planning agencies for planning airport systems, and to public agencies for developing airport master plans. The Secretary will presumably delegate administration of this Section to the FAA, which already maintains the National Airport Plan; if funded properly, this section will give the FAA, for the first time, enough authority and money to grant funds specifically for airport

planning. To ensure coordination and prevent duplication, the Secretary of Transportation and the Secretary of Housing and Urban Development "shall develop" joint procedures. Consistent with this logic, Section 16 provides that any public agency or agencies submitting requests for funds for airport development shall receive them only if "the project is reasonably consistent with plans. . . of planning agencies for the development of the area. . . ."

The sum total of Federal Government legislation in the airport siting area add up to an excessively flexible policy of encouraging the development of airports within and by urban communities through moral suasion. At times, the policy sounds like the Federal Government is going to get tough, either by reviewing airport plans directly, or by requiring local planning agencies to review airport plans as part of comprehensive planning programs. At other times the policy sounds as though Federal Government agencies will be integrating airport policy planning activities and eliminating plans which conflict with or do not serve the long-run interests of agency clientele (e.g., the construction of FHA high-rise multifamily housing in close proximity to runway clear zones or high PNdb noise contours).

However, the sound signifies little. The wording of the laws permits but does not require effective local planning and interagency cooperation. Ultimate responsibility for insuring rather than "considering," or for directing rather than "consulting" is absent. Nonetheless, the recent *Airport and Airway Development Act* opens the door for a strong executive lead position vis à vis airport siting. With small modification of the Act to cover landside development, one can see a real opportunity for the Federal Government to assert itself in airport siting.

If the Federal Government is so close to exerting strong leadership here, and if the airport siting problem is so pressing, why hasn't the situation eased through vigorous Federal leadership?

The fundamental constraint on Federal action here is the traditional notion that land use determination should be accomplished at the local level (i.e., a *political-attitudinal constraint*). In many ways airport planning is even more complex than highway planning, and the energizing of Federal leadership here probably runs counter to the tenor of the times. In New York for instance, not even the state's Urban Development Corporation (UDC) has been able to exercise its legal power to override local zoning for fear of political reprisal. (As it is, there are a number of bills in the legislature to strip this portion of UDC's power.) This resistance to Federal direction is further illustrated by Congress' elimination of a clause in the *Airport and Airways Bill*, requiring the Secretary to select a fourth airport for New York.

Insofar as interagency cooperation is concerned, the constraints are of a different stripe — they are more in the area of bureaucratic misplacement of goals with a strong assist from the political. To begin with, Congress made clear in the *Department of Transportation Act of 1966*, Section 4 (b) (2), that the Secretary of Transportation should not adopt, revise, or implement any transportation policies, and that operating and program responsibilities were to remain with the several modal administrations. This policy seems contradicted by both the *Airport and Airway Development Act of 1970* and the proposed *National Transportation Act*. The former as quoted above charges the Secretary with formulating a national transportation policy. The latter calls for the Secretary “to provide for . . . coordination of transportation, including therein the undertaking of research and development and the conducting of demonstrations . . .” In any event, the Secretary must confront established bureaucracies in FHA, FRA, and the FAA — each with their own clientele, and each with unique sources of funds and political strength in Washington.

6. POLICY OPTIONS

In the preceding discussion of the Federal Government response, some opportunities for both modal harmonization and Federal leadership were outlined. Which other substantive policies could break the present impasse? Which ones might facilitate modal harmonization and more aggressive governmental leadership at all levels?

a. Market Aggregation and Demonstrations

The Federal Government appears to have several options that would facilitate the aggregation of markets. First, it could enlarge its capability to evaluate certain landside developments (including ticketing, automated baggage handling, access systems, people-movers, freight and materials handling, etc.). A long-run relationship with a “think tank” not unlike DOT’s association with MITRE or RAND, or broader utilization of DOT’s recently instituted Transportation Systems Center, could help to build up in-house expertise. This capability would be compatible with present government organization and legislative underpinning. Not only would such a program demonstrate government concern and commitment, but it would also help industry to perform a critically needed assessment of new technologies.

The weakness of the option is that it does not directly solve industry problems in terms of aggregating markets, an especially thorny issue in respect to landside technology. It is an approach which helps channel R&D, but does little to trigger it, unless the option is coupled with other more directly market-oriented programs. In the words of the president of one of the foremost firms in the ground transportation industry, “The Federal Government is virtually the

only institution that can provide an incentive to industry to invest in our ground access system — not only because there is a need for it, but more importantly because the Congress and the Secretary of Transportation had identified an active requirement for such a transportation system.” This view bolsters those alluded to previously in this section; that the private sector cannot guarantee a market for industry. Therefore, say many businessmen, improvements in ground access whether by fixed-right-of-way or bimodal vehicle can only be assured through Federal Government intervention in the marketplace. But, there is still some question whether Federally-supported markets will necessarily lead to accelerated R&D and progressive innovation. For example, government intervention in housing has helped in developing markets but has not had a salutary¹ effect on innovation. Another weakness of this option is that it could become an extremely costly program. Development costs may run in excess of \$5 or \$6 million per mile for existing technologies. Proliferation of fixed-right-of-way systems could serve to divert substantial amounts of capital at a time when money and credit are scarce and urban needs are being intensified. Therefore, a reasonable compromise might be expanded support of access and other hardware demonstration programs that could prove market feasibility of present technology; and support of research which may well contribute to the technology of the future (e.g., tube transit vehicles).

The present UMTA program does now fund several airport demonstration projects (including an internal people mover at Dallas — Ft. Worth), but they are incidental to UMTA’s responsibility to support urban transit demonstrations. On the other hand, demonstrations are costly and present funding commitments do not permit many proof-of-concept demonstrations — even for urban transit. It should be pointed out, however, that neither option creates a market. Rather, the approach is designed to stimulate R&D directly, instead of setting up markets to which R&D would respond.

b. Coping with Attitudinal Constraints

The attitudinal-environmental constraints associated with R&D may be dealt with in several ways. As stated earlier in this study, the one approach that is perhaps inappropriate for the 1970’s is to cling to the view that given sufficient time, technology will solve all problems. Chances are, given the present hostile mood of many Americans regarding certain new technology, that this time-honored approach will fail. The attitudinal flip-flop toward technology on the part of so many is attributable to sudden mass awareness of undesirable second-order effects, or social costs of technological innovation. Therefore, the useful options would seem to lie in the area of attempting to carefully plan system requirements, including anticipated social costs. Because it is difficult to assess the effects of technological innovation in an era of rapidly shifting social values, it is probably more feasible to set system requirements in terms of environmental

needs and then work toward the appropriate technology. In other words, the system to be optimized is not necessarily air transportation in urban areas *per se*, but air transportation as constrained by the types and location of airports which are consensually acceptable. The problem is not one of developing the technology which bears the least technological risk or which holds the greatest payoff if developed within the rules of the present air transportation "game." Instead, the problem is one of anticipating the system requirements attendant upon the *qualitative* needs of the country for improved air transportation. At present, government and the marketplace are not beaming this message to industry on the same frequency. If aviation is to be perceived as a travel mode benefiting other than a few businessmen and "jet-setters," it must tread very carefully on the increasing sensibilities of the general population.

The specific options flowing from this analysis include undertaking R&D which puts priorities not only on needed hardware (e.g., a full-blown Northeast Corridor V/STOL demonstration), but also on the software (e.g., developing airport siting criteria and social impact analysis). The Federal Government can also attempt to broaden constituencies for civil aviation by developing synergistic multipurpose regional programs. For instance, the Federal Government could promote the acquisition of land for airports far in advance of need by wedding it to an open space program. Conceivably, all the airport land purchased would not eventually come into airport use, thereby preserving greenbelts and parkland from the encroachments of sustained development at the urban periphery. It would have the additional benefit of keeping the options open for larger cities; that is, it would give city decision-makers considerably more flexibility than they now have when airport needs arise, which land must be purchased, and when airports must be planned on an *ad hoc* basis.

Ground access and the development of fixed-right-of-way systems present similar opportunities to broaden aviation's constituency. Programs that use highway rights-of-way, as in the case of the LAX TACV (Los Angeles tracked air cushion vehicle) demonstration, provide a beginning. Given the present urban housing and transportation problems, it *might* be feasible to sponsor housing and industrial development programs in "linear cities" built up alongside and over the ground access system. Such policies would not only raise urban residential densities, but would in the process relieve the pressures creating a low density spread city in the outer rings.

The disadvantages of the approach arise from the expectations generated by such ambitious programs. We really don't know if one can "package" government programs. Nor do we know if people want "linear cities," new towns, or similar visionary projects. It is not unreasonable to expect that a *hard bargain* would have to be struck with conservationists if advance acquisition of land for both airport and wilderness preservation purposes were to be packaged together.

Remedies for peaking problems are largely beyond the scope of aviation or even transportation policy. The cause of the problem lies in the work habits of most of Western Civilization. These patterns can be easily changed incrementally but not comprehensively. Offices and industry can open up and close a half-hour or an hour earlier than usual. Airports can limit flights and impose differential user charges that curtail general aviation use of the airport at peak times. But the fundamental desire to maintain diurnal work patterns remains.

The tendency for bureaucracy to lose sight of the public interest and focus on agency-oriented objectives presents another difficult problem. Governmental self-study and periodic reorganizations provide some relief from entrenchment of bureaucracies. Currently, there is an internal proposal in the Presidential Reorganization Plan calling for the creation of a United States Transportation Commission (USTC) consisting of the CAB, ICC and FMC. The USTC would establish and execute a unified regulatory policy for the entire transportation industry. We have had no opportunity to evaluate the reorganization proposal, but we believe that periodic reorganization of such agencies may be desirable in order to keep everyone in government alert to the shifting problems of the regulated private sector.

The problem of fragmented government offers no easy remedy, creation of special-purpose districts, and government consolidation notwithstanding. Nonetheless, the Federal Government can provide incentives for local governments to behave in coordinated ways. For instance, the Federal Government could withhold funds for airport development until an acceptable plan for airport access is provided by the region. Moreover, the Federal Government could channel funds through state governments as a means of sharpening their interest in resolving regional conflict. Current concern with participatory democracy and home rule, combined with an emerging pattern of racial and social stratification in some metropolitan areas, probably serves to limit the success of programs designed to educate the public in the purported virtues of "metro" or regional government. Only by combining a vigorous program of access and airport siting (e.g., V/STOL) demonstrations with a reasoned grants-in-aid policy designed to maximize comprehensive planning, can one foresee a reduction in conflict engendered by the proliferation of political jurisdiction.

c. Smoothing Out Financing and Legislation

Three alternate approaches to sharpening the Federal focus on airport access and improving the financing of access planning and development are:

- To formalize and strengthen multimodal transportation planning at the federal level;

- To amend trust fund legislation so that monies may be channeled into transportation planning and the improvement of ground transportation in and around airports; and
- To establish a new program and structure for funding transportation system planning and development at the local or regional level.

Each option should be considered in greater detail. First, administrative machinery for coordinating the funding of comprehensive transportation planning at the local, metropolitan and regional levels has existed for years. Nonetheless, there is not much evidence of cooperation and farsighted planning. A possible reason for inadequate airport access planning is that despite attempts to coordinate airport access, each of DOT's modal administrations has a singular approach to planning and financing, plays to a different clientele, and provides little inducement for comprehensive planning agencies to consider airport access. Presumably, if aviation interests were more adequately represented in the internal Federal Government process of planning mass transportation and/or highways, airport access would move out of the shadows. A promulgation of parallel regulations and supporting memoranda by the various modal administrations could produce this effect. In this way, FHWA, FAA, and UMTA could each designate field staff with responsibility for insuring multimodal planning and coordination. One way of implementing this option would be to establish an Office of Multimodal Coordination in each modal administration. The coordination office could have a director in Washington and field staff representatives at the regional, state, or local level. However, the existing field staffs of FHWA and FAA are not organized in a complementary fashion. Moreover, UMTA has no field staff at all. Still, this situation could be resolved without new legislation.

Another approach might be to establish an Office of Multimodal Coordination under one of the Assistant Secretaries of DOT. This approach has the benefit of eliminating possible modal bias or narrow-mindedness, but is not feasible at the present time because DOT has no field staff; since Federal transportation program priorities have traditionally been established at the local or regional level, a field staff is essential for effective control.

Multimodal planning will probably be implemented in some manner. Each of the two basic approaches described above is presently being evaluated. As one might expect, the modal administration officials generally favor maintaining responsibility within the modal administrations. For several months representatives from FAA, FHWA, and UMTA have been meeting informally (with HUD participation) to outline the form which this approach might take.

Simultaneously, the Office of the DOT Assistant Secretary for Urban and Environmental Systems has been examining the feasibility of making such coordination its own responsibility. This Office has responsibility for coordinating transportation policy and activities with other Cabinet-level departments. Thus, in the House Appropriations Committee hearings on DOT appropriations for 1970, the office head stated that his office carries out DOT's coordination responsibilities under Section 4 (f) of the DOT Act of 1966, the National Environmental Policy Act, and provisions regarding urban planning coordination.

A problem with formalizing existing procedures comes in persuading Congress to appropriate additional funds for necessary field coordinators; the approval of additional appropriations for new staff positions can never be guaranteed. On the other hand, Congress might be persuaded that these outlays represent an alternative which is far less expensive than funding a wholly new airport access program. Although there is a theoretical possibility of formalizing the coordination responsibility without new Congressional funding, there is likely to be intramodal resistance to doing so.

The second option hinges on the view that airport access will never be given high priority at the Federal level unless Congress enacts and funds a program for financing improvements in the ground transportation system in and around airports. According to proponents of this view, there is little reason to believe that Federal transportation administrations will suddenly accord airport access priority as long as there is little organized pressure to do so. Furthermore, none of the various modal administrations particularly focus on airport access. The FAA feels that its responsibilities end at the airport gate. UMTA thinks in terms of mass people movement and does not believe that great numbers of people are involved in the movement to and from the airport. FHWA (Bureau of Public Roads) has shown more interest in airport access than the other administrations, but even FHWA tends to feel that the access problem has low priority in the vast majority of cases.

Approaching the access problem through legislative amendment may prove fruitless unless strong local airport access constituencies are developed. The legislative history of the Airport and Airway Development Act of 1970 would support the view that legislation on airport access is not likely. While a number of witnesses before the House and Senate Commerce Committee pointed to the existence of inadequate airport access systems, only the Airport Operators Council emphasized the problem and its urgency.

One option calls for national transportation planning by means of amendments to existing modal planning programs which would require planning by comprehensive local or metropolitan planning bodies. Thus, technical studies grants of UMTA under the Urban Mass Transit Act of 1970, Airport planning

funds under the Airport and Airway Development Act of 1970, and highway planning funds would all be directed to a designated planning agency. This would be quite different from the present framework under which area "clearinghouses" comment on the various pieces of modal planning. All the relevant acts would have to be amended. To be truly comprehensive, this transportation planning process would also have to be meshed with land-use planning by HUD. As noted elsewhere, the requirement for HUD-DOT cooperation already exists and is to be formalized by regulation under the Airport and Airway Development Act.

Carrying this idea one step further, Federal developmental grants and loans could be made consistent with the intermodal planning of the designated comprehensive planning unit. This could be accomplished by amending existing programs so that all such grants flow through the agency that is doing the local planning. At this point we are undoubtedly stretching credibility; it is unlikely that any planning agency in this country would be given such concentrated power.

Perhaps the most sensible way in which to finance airport access and passenger movement within airport terminals would be out of a single transportation trust or unitary transportation fund. The concept of such a financing mechanism for our problem is particularly appealing since ground transportation in and around airports obviously can directly involve any modal administration. The idea of a single transportation fund has the strong personal support of Secretary Volpe but is one of the most controversial issues before Federal transportation policy-makers. Without attempting to analyze the issue in any satisfactory way, consider the pros and cons of the single fund concept and the perceived attitudes of Federal policy-makers toward it. For the sake of clarity, this discussion focuses on a single transportation trust similar to the Federal highways and airways trusts. An argument in favor of a single trust is that it facilitates flexibility in channeling funds where needed at a particular point in time. Senator Kennedy, for one, has argued that modal trusts can outlive their usefulness, and yet be self-perpetuating. Many members of Congress are apprehensive about the single trust fund concept because it tends to loosen their hold on the appropriations purse string. Others argue that the auto should not subsidize the rail or air traveler; this assumes that each modal travel group is homogeneous, and that there is presently no discrimination among groups. Traditionally, both FHWA and FAA have not been in favor of the single fund. Both administrations have their own monies and become concerned over any prospect of "siphoning." Nevertheless, many officials recognize that at least ultimately the unitary fund will become a reality.

One other legislative approach deserves mention. Secretary Volpe and DOT offer rather strong support to the establishment of State Transportation Departments. The Nixon Administration Airport and Airway Bill sought to have Federal aid channeled through State Aviation Departments. Presumably, there would be

certain benefits in channeling all Federal aid to transportation through a single state agency. Congressional resistance would probably rest on a justifiable concern that urban areas would be shortchanged in the process. But again, through this single agency approach, intermodal conflict would presumably be lessened.

The third option involves the argument that establishing a new regional structure for transportation planning and development would be generally helpful, and likely to bring airport access problems specifically into focus. Planning at the broader regional level would likely have the following benefits:

- Bringing together participants responsible for a larger geographic area and thus ensuring compatibility over a wider area;
- Examination of logical modal interfaces through a balanced approach; and
- The general pooling of resources on a multistate level.

d. Placing Options in Perspective

The *ultimate* success of airport landside progress rests not on an occasional demonstration, remedying present legislation, or, within the modal administrations, issuing more memoranda designed to promote "cooperation." Rather, a strong constituency must be built up for airports and airport access systems. If this is not possible, given the mood of the country, a serious question must be raised as to whether the industry growth prophecy will be fulfilled. However, if congestion halts the growth of the largest urban centers, perhaps the nation's less densely populated areas will grow more rapidly than anticipated, thereby producing a silver lining to the present storm cloud of uncertainty.

IV. SUBJECT AREA REPORTS

SUBJECT AREA REPORTS

The following subject area studies were selected in consultation with the Joint Study management as initial focal points for identifying institutional constraints. In the absence of specific R&D goals, e.g., the development of a STOL system, a DC-3 replacement, a hypersonic transport, etc., it was necessary to focus our analysis by identifying various categories of possible R&D application. This way we were able to discuss specific issues and potential R&D programs rather than the broad question of constraints on civil aviation research, development, implementation, and operation of new or improved systems. Such a broad question would yield equally general answers which would be of little, if any, use.

A constraint can be identified only in terms of a particular objective; it is impossible to discuss a constraint without knowing what is being constrained. In effect, by selecting subject areas, we were also selecting various categories of imputed goals. For example, the "General Aviation" analysis assumes, at least initially, that better, safer, and *more* general aviation activity is desirable — that is, an imputed goal.

Over 175 field interviews were performed with key persons in the aerospace, airline, and general aviation industries; federal, state and local governments; and universities. In effect, we asked, "What is it you need or would like to see developed, and why is it not being done?" In this way we were able to identify most or all of the institutional constraints inhibiting the civil aviation R&D process.

During the analysis phase of this effort we applied our collective experience and judgment to what had been, up to that point, a cataloging of constraints as perceived by our respondents. We feel the results give a more balanced description of constraints to the civil aviation R&D process in each of the subject areas studied.

Initially, six major subject areas were studied:

Airport Access

Short-Haul Systems

Airline Profitability and Long-Haul Systems

Special Aviation (general aviation, including third-level carriers but excluding the military)

Air Cargo

Airports

The following material contains subject area reports on STOL, Commercial Helicopter Operations, Air Cargo, and General Aviation. Information on Airports, Airport Access, and Airline Profitability is included in Section III of this report, entitled "Legislative and Regulatory Factors," since these subjects are inextricably bound to issues discussed in that section.

COMMERCIAL HELICOPTER OPERATIONS

1. INTRODUCTION

The history of commercial helicopter operations in the United States provides an excellent case study of the importance of carefully examining the specific facts surrounding the application of new technology in an experimental program before drawing generalized conclusions concerning the potential merit of the plan at a different place and under different circumstances. It also illustrates how regulatory authority can be used effectively to develop market information and experimental data at relatively low cost, thus ensuring that sound programs will receive adequate support once proof-of-concept has been completed, while at the same time avoiding massive expenditures of public and private funds on projects which are likely to fail.

The story of helicopter transport is that of a program which began with an obvious and clearly visible limitation — it had very high direct operating costs. Apparently offsetting this admitted liability, however, were a whole range of favorable conditions. The most important of these was a popular public image. The Korean War had made the helicopter famous and intriguing visions of avoiding the boredom and irritation of daily traffic jams caught the public imagination. The minimal land required for a heliport, moreover, appeared to offer hope of avoiding the myriad of problems connected with building vast new airports for fixed-wing aircraft, while at the same time offering to everyone the freedom and flexibility of the automobile. Twenty years ago the distinctive sound of the helicopter was more a hallmark than a nuisance. To those more sophisticated in the problems of modern civil aviation, helicopters offered the hope of providing a major contribution to strengthening aviation's role in a different market — intracity and short-stage, intercity transportation.

The admitted problem of high operating costs did not appear overwhelming. The equipment in use has been largely developed for military applications where operating costs were not regarded as critical, and it was widely assumed that American technological ingenuity would prove equal to the challenge of erasing this limitation. In 1968, the CAB reported direct operating cost of the S-61 in use by the scheduled helicopter carriers averaged 12.0¢ per available seat-mile, compared to 1.7¢ for fixed-wing equipment. Direct estimated operating costs of the proposed 86-passenger compound S-65-200 (used in the CAB Phase I Study) were 3.7¢ based on a 200-nautical-mile stage length. This reflects both a significant potential reduction in cost per seat-mile and the important effect of utilizing the aircraft over greater stage lengths.

In spite of hopes for continued improvement, the power-drag relationships associated with currently available helicopters or the next generation of compound aircraft suggest that there may be an unacceptable economic penalty

associated with this type of vehicle. The attitude of both helicopter manufacturers and the major airlines which have examined the economics closely can be succinctly summed up in the comment of one: "An economical VTOL has been around the corner longer than any other projected advance in aircraft technology."

Now, after 23 years of certified scheduled helicopter operations and in spite of direct government operating subsidies of over \$50 million, three of the nation's four scheduled helicopter carriers are still operating at best on a marginal basis, and the fourth is in bankruptcy. This is in sharp contrast to the growth of the fixed-wing airline carriers during the same period. The expectations for helicopter operations that led to the long period of subsidy and private financial support have not materialized as forecast by their proponents. While some significant improvements have been made in the quality of passenger service and major reductions in seat-mile cost have been achieved, self-sustaining profitability has remained an elusive goal.

While this lack of success has been a severe disappointment for those who favored helicopter transport, it has demonstrated the effectiveness of operating subsidies as a relatively low-cost device for testing the sensitivity of the market to lower fares. The use of such subsidies, both federal and commercial, provided a market testing opportunity at far less expense than subsidizing the high-risk development of a full-blown VTOL system.

In the case of helicopters, the heavily subsidized tariffs provided an opportunity to uncover a more basic constraint, the effect of which had been previously disguised — the lack of a basic market demand at or near the fares required to operate the service.

2. SCHEDULED HELICOPTER AIRLINES

There are four scheduled helicopter airlines in the United States. All but one have been in service since the late 1940's and early 1950's. Until 1965, New York Airways, Inc. (NYA), Los Angeles Airways, Inc. (LAA), and Chicago Helicopter Airways, Inc. (CHA), were operating with a subsidy authorized by the Civil Aeronautics Board. The fourth carrier, San Francisco and Oakland Helicopter Airlines, Inc. (SFO), operated without subsidy throughout its entire life which began in June 1961. Each of the airlines' passenger traffic is discussed below in terms of where the business came from and what problems were encountered.

a. Los Angeles Airways

Through austere management practices and a subsidy that ran from a low of \$684,000 in 1954 to a high of \$1,803,000 in 1963, LAA experienced steady

growth in passenger traffic — particularly beginning in 1961 as a result of conversion to the twin-jet-powered Sikorsky S-61 28-place passenger helicopter. The sprawling Los Angeles basin area served as a fertile market. Furthermore, a special situation existed between Los Angeles International Airport and Disneyland that provided two unique concentrations of origin and destination traffic without the need for local transportation at either end. Also, LAA from its inception in 1947 has carried U.S. mail and freight throughout the area within a roughly 50-60 mile radius of the airport. In addition to the subsidy which was terminated in 1965, the airline has many interline agreements with trunk and regional carriers at Los Angeles International Airport. These agreements provide for reduced helicopter fares for passengers connecting with sponsoring carriers; the balance of the regular fare is paid by the airline to the helicopter operator. This encourages passengers to use the sponsoring carrier and provides a subsidy for the helicopter operation. Even after termination of the government subsidy, passenger traffic rose through 1967. The abrupt downturn in 1968 stemmed from the loss of two S-61 helicopters and a probable decline in traffic attendant on widespread national publicity given to these two crashes. The results at LAA included a reduction in fleet size from four to the current two operating S-61's, and an attempt to cut costs further by resorting to more economical Twin Otter aircraft in 1969 for certain route segments. The situation was further exacerbated by a six-month pilot strike from the end of October 1969 to May 1, 1970. Since the strike, passenger traffic has quickly expanded so that continued growth appears likely, but from a substantially reduced base.

What is most evident about LAA's traffic history is that it does not appear to be even loosely related to the burgeoning economy and population of Southern California. Instead, it appears to rely on special situations, all of which are subject to competitive modes of travel. Endless competition from the road network clearly has eaten into traffic from downtown Los Angeles and the San Fernando Valley. More recently, activity by a number of commuter airlines serving the greater Los Angeles region has clearly hurt LAA's potential, particularly from towns to the east of Los Angeles. The tracked air cushion vehicle experiment now under study for operation from the San Fernando Valley to the Los Angeles International Airport would also undoubtedly cause some reduction in traffic for LAA from that area.

b. New York Airways

New York Airways has grown principally on the basis of the special situation that exists as a result of the ground travel problem between New York's three major airports and Manhattan. These four concentrations of air traffic origination and destination coupled with inadequate and uncertain ground transportation have provided the basis for NYA's growth. NYA received yearly subsidies ranging

from \$1,417,000 in 1955 to a high of \$2,577,000 in 1961. This subsidy money was used aggressively to experiment with various additional markets such as White Plains and Stamford to JFK and commuter service as far west as Trenton, New Jersey.

The termination of the subsidy in 1965 coincided with inauguration of the unique Pan Am Building rooftop helicopter operation, which was the principal reason for the major buildup in traffic in 1966 and 1967. This remarkable innovation in air travel, although restricted by regulations and local ordinances, was highly successful. For a number of reasons not relevant here, service was terminated in 1968. Rising operating and overhead costs forced NYA to curtail service sharply as it sought to bring costs in line with revenues. The years 1968 and 1969 were touch-and-go for the financially beset carrier.

New financial arrangements included 45% stock ownership in the airline by Pan American Airways in October 1969, and substitution of S-61 equipment (purchased by Pan Am and leased to NYA) for the aging Vertol V-107 fleet in March 1970 set the airline on a new course. Using just two operating and one spare S-61's, and a highly organized, spartan, three-stop service, the airline carried over 30,000 passengers in the month of July between JFK, LGA, and Newark only.

Like LAA, NYA receives effective subsidy from a large number of airlines with which it has participating fare or interline agreements that absorb from 40% to 100% of the passenger's cost of the helicopter ticket.

The problems encountered by NYA are similar in many respects to those in Los Angeles. Gradual erosion of markets through introduction of new ground transportation systems have reduced the enroute time advantage. The Narrows Bridge providing a reasonable ground link between Newark and Kennedy airports, and completion of the Brooklyn-Queens Expressway are but two examples. The proposed rail link between Manhattan and JFK will certainly adversely affect NYA's business potential if and when this facility is completed.

c. Chicago Helicopter Airways

Chicago Helicopter Airways grew and died as a result of one special situation: the Midway-O'Hare operations from 1956 through 1962. A completely unpredictable decision by the CAB set up this special traffic situation. This was an order that forbade scheduled carriers from operating the same flight into both fields during the transition period from Midway to O'Hare that started in earnest in 1958. As a result, CHA's business boomed until Midway closed its passenger business in 1962. Only modest business was ever obtained from Chicago's city center to either airport or from the affluent South Side commuter center to the airport.

As was the case in New York and Los Angeles, when the special situation disappeared, traffic fell off dramatically. Despite continued subsidies of between \$1,784,000 in 1962 and \$800,000 in 1964, CHA was forced to terminate scheduled operations at the end of 1965. Erosion of the always-limited Loop-to-O'Hare traffic was also accelerated by the completion of the Kennedy Expressway in 1962.

CHA experienced considerable difficulty and was ultimately unsuccessful in obtaining downtown heliports within the business district because it operated single-engine, piston-powered equipment (Sikorsky S-58's). The FAA imposed what CHA still considers unreasonable safety standards which effectively blocked its ability to operate from heliports in the business district (on the west side of Michigan Avenue instead of Meigs Field). CHA never had a chance to use four S-61 helicopters it had on order before lack of market forced it out of business. Clearly, lack of market was the dominant cause of CHA's demise. However, like the other helicopter airlines operating with very costly equipment, profitable business without a subsidy in one form or another was impossible.

d. San Francisco and Oakland Helicopter Airlines, Inc.

SFO entered business in 1961 with jet equipment (Sikorsky S-62) and rapidly changed to the more economical S-61. It now operates four S-61 helicopters in the San Francisco Bay area. Sixty percent of SFO's business comes from the 56 scheduled eight-minute flights operating daily between San Francisco and Oakland International Airports. While most of SFO's business stems from this interairport service which is easily recognized and has clear attraction to the traveling public, it has made significant efforts to capture commuter-to-airport traffic. Unfortunately, these efforts have not been particularly successful. With the recent downturn in business undoubtedly being a major factor, SFO has had to file a petition of bankruptcy and is currently restricting its operations to its most profitable routes only. Moreover, SFO can expect to see further inroads to its market as BART (Bay Area Rapid Transit) extends itself from city center to the San Francisco Airport and perhaps at a later date to the Oakland Airport.

3. HELICOPTER AIR TAXI OPERATIONS

The other major class of helicopter passenger-carrying operations is comprised of private and public air taxis operating small two- or four-passenger helicopters, most of them made by Bell. Although the possibility of using a small helicopter in an on-call taxi mode was recognized with the inception of the helicopter, its growth has been quite limited.

The air taxi market can be thought of as being made up of two segments:

- Air taxi and random charter on a scheduled or unscheduled basis for transporting people within a metropolitan area, based on either a daily charter or fixed-fare basis.
- Corporate air taxi (either owned or chartered) for transportation of corporate executives from one plant to another or from plant to airports.

The air taxi and corporate markets are quite similar — both depend principally on business travel since the cost of air taxi helicopter operation precludes significant use for intra-urban transport by commuters, shoppers, tourists, etc. The major difference between these two segments is whether the helicopter is paid for on a fare basis and operated by an outside organization or whether it is owned or chartered on a long-term basis by the passenger or his own company organization.

Approximately 100,000 to 120,000 hours of helicopter time are flown per year, divided roughly equally between the air taxi and corporate markets. Growth rate has been modest and is highly sensitive to the general state of the economy.

The air taxi market has not grown for a number of important reasons:

a. Lack of Market Potential

While the rapid growth of metropolitan areas and urban sprawl should seemingly stimulate the demand for air taxi service, in fact it has not. The reasons for this include a combination of factors. Effective utilization of helicopters depends upon a concentration at both origin and destination of large numbers of potential customers. The urban sprawl, however, has just the opposite effect. Also, the general movement toward improved mass transportation via the federal highway system or, more recently, consideration of ground links between various metropolitan subsections has clearly held back market growth.

An increasingly important stumbling block has been the problem of building suitable landing sites for the helicopters in order that both the advantages of the vertical life and hover capabilities can be realized and the services of the helicopter made convenient enough so that intermodal travel is not necessary when they are used.

To some extent the corporate segment of the air taxi market has been able to solve this problem more effectively, as companies can grant access by helicopter to multiple plant locations in a given metropolitan area. This, in fact,

accounts for the current high proportion (80%) of the nation's 2,000 heliports being under private control. (The percent varies from 60% to 90%, by state.)

The commercial air taxis have fared far less well in their efforts to establish convenient downtown heliport locations. In the greater Los Angeles area, which covers roughly 4,000 square miles, there are currently about 84 active heliports. About 16 of these are open to public air taxis, giving a net density of one for every 500 square miles. More recently, the concern over noise caused by any aircraft has prompted the State of California to conduct noise surveys and establish standards. Standards for the Bell 204 helicopter now appear to restrict it from landing any closer than three-quarters of a mile from a building housing offices or residential structures. Clearly, this could almost eliminate consideration of using this ship effectively in the crowded Los Angeles basin. There has been a significant lack of governmental interest in studying heliport requirements and setting standards. States still control local standards and these are highly variable from one state to the next. This is particularly troublesome where a metropolitan area includes two or more states as is the case in New York, Philadelphia, and Washington, D.C.

Another problem in obtaining heliport authorization relates to the reluctance of city, state, and federal authorities to allow single-engine operation of helicopters over crowded city areas. The answer is small twin-engine helicopters, but up until now none have been available (although several are now in the offing in the eight- to twelve-passenger category). Unfortunately, the very capacity necessary to justify the expense of a civil twin-engine design mitigates against the concept of small-capacity, high-frequency taxi service and is unlikely to stimulate the business.

Recently, the helicopter industry — compelled by necessity to get some standardization — established the National Heliports Standards Council to help bring some concerted pressure on those federal and state agencies concerned with the problem of the nation's heliports.

b. Benefit-Cost Equation

Even if substantial markets did exist or could be developed, the benefit-cost question makes the use of helicopter air taxis out of reach for all but an extremely small segment of the potential traveling public. The principal cause of this is the high price of helicopter acquisition and operation. The typical four-passenger helicopter today costs \$100,000 as compared with \$3,000 for a taxicab of similar capacity.¹ Amortization of this initial cost — as is true with any

1. Besides having to amortize 33 times as much investment on its useful life, the wages of a pilot are an order of magnitude over those of a cab driver.

aircraft — depends upon high utilization. Despite a number of intensive efforts to develop air taxi operation mounted in the past ten years (particularly Air General's defunct Logan-Route 128 service), none have been able to successfully surmount the hurdle of how to achieve high utilization. This in turn has resulted in the necessity of charging high fares of from \$1 to \$2 per mile traveled. Clearly, for short distances of four to perhaps eight miles, this fare itself might not be excessive where the benefits were clearly perceived by the traveler. However, for the longer distances, even where a significant saving in travel time might be realized by the potential customer, the fares begin to loom as a significant deterrent to use.

It must be concluded that the helicopter air taxi has only a marginal capability in the total civil aviation transportation network and that it will not in the foreseeable future be capable of significant contributions to the movement of large numbers of travelers. This statement might be erroneous if a heliport existed at both ends of a heavily traveled link — but then, the chances of installing the heliports in light of real estate costs and opposition by heliport neighbors make this a rather unlikely course of events.

STOL SYSTEMS

Major examinations and a number of smaller studies of the place of STOL aircraft in short-haul transportation have been made over the last five years. These studies all have agreed that appropriate STOL aircraft are well within reach technically and the service they could provide is needed. Nevertheless, no such aircraft are in fact operational (aircraft like the Skyvan, Twin Otter, etc., are really CTOL aircraft with low wing loading rather than true STOL airliners), nor does there appear to be any immediate prospect for their development.

This section presents an analysis of the constraints which appear to be inhibiting the introduction of STOL aircraft into short-haul transportation, and possible solutions.

In our interviews and examination of past studies of STOL transportation, frequent references were made to "the impasse," "the iron ring" or "the chicken and the egg" as similes for the situation where the need for a STOL system is widely recognized but no governmental agency or industrial firm is acting in any significant way to fill the need.

The symptoms of this impasse may be summarized as follows:

- The aircraft industry is ready to start development of first generation STOL transports but is unable to find any customers for them.
- The trunk and regional airlines are preoccupied with their present economic problems, including how to finance CTOL equipment already on order. Their experience tells them that short-haul traffic is unprofitable, and they are not disposed nor are they in any financial position to embark on any experiment that involves so many unknowns as STOL short-haul.
- The third-level carriers generally lack the depth of management and financial resources necessary to operate a STOL transportation system.
- Investment capital is increasingly difficult for the airlines to obtain because of their currently poor rates of return. The prospects of raising the large amounts needed to finance a STOL system are remote.
- Local authorities who would be responsible for siting and constructing STOLports will not consider undertaking these

in any numbers until some carrier has firm plans, adequate financing and CAB approval to start a STOL service.

- The CAB still is in the early stages of a Phase II examination of the feasibility of STOL service for the Northeast Corridor and undoubtedly is some years away from authorizing any carrier to operate STOL equipment.
- The FAA has no definition of STOL aircraft nor any specification of basic requirements to which such aircraft should be designed.

There is a sort of hierarchy in the long list of factors constraining the introduction of STOL aircraft into short-haul service. At the top of this hierarchy is a consideration not generally recognized explicitly by the participants in the impasse: *there is no historical precedent for the rapid introduction of a transportation system radically different from those already in use.* Even the steamship and train started out with performance and passenger capacity not significantly in advance of those provided by the sailing packet and the stagecoach, and took several decades to prove themselves clearly superior to and more reliable than their competing systems. A STOL system, on the other hand, if it is to realize its apparent full potential, must employ aircraft of a type that have not yet been built for commercial use, utilize landing facilities that are very different from those to which local authorities have become used, have available a separate structure of air traffic control, and be directed toward a market, the existence of which is as yet hypothetical. It is not realistic to expect that, even in the most favorable of political and economic environments, the theoretical need for such a complex system could be transformed into a market and sufficient financial and legislative support be found to bring it into being in a short time. Likewise, it is understandable that no one knows exactly what to do in such a situation.

A second important constraint is a perceived *absence of a market sufficiently certain to warrant an aircraft manufacturer placing a STOL aircraft in development.* Without the prospect of enough orders by airlines to justify the risk of beginning a costly development program and with most of the large airframe manufacturers heavily committed to existing programs, none are in a position to sponsor a STOL transport as a private venture.

Another major constraint to the establishment of a STOL system is that *there is no conviction on the part of the airlines that such a service could be operated at a profit.* Short-haul routes traditionally have been unprofitable. Present fare structures are such that airlines must support short-haul routes with the more profitable long-haul ones, or, if they have no long-haul routes, by Federal subsidy. The economics of a STOL system will depend on the estimated

operating costs of a kind of aircraft that has not yet been built and on the number of passengers it can attract away from other kinds of transportation (CTOL included), which in turn will depend on how close STOLports can be built to the points of origin and destination of the largest number of passengers. In the face of these major intangibles, it is understandable that the airlines do not feel able to invest in STOL aircraft at this time. Compounding the problem is the fact that recently the economic situation of the airlines has deteriorated substantially. Almost all airlines are facing increasing operating costs, lower-than-forecast passenger volume, heavy financial burdens and extensive commitments to new equipment on order. Almost without exception the airlines have assumed heavy debts to pay for aircraft already delivered or on order, and have not been able to achieve the revenues anticipated when the debts were incurred. Even were the economic potential of STOL short-haul more obvious than is the case, the airlines would find it very difficult to pay for the required equipment.

In addition, the aerospace industry is confronted with a rapid decline in military orders as the level of conflict in Southeast Asia falls off, with significant reductions in the space program and with reductions in new orders for commercial transports. These factors, leading to declining revenues and profits, together with criticism of and legislation against federally subsidized independent research and development, substantially reduce the industry's ability to develop major new aircraft as private ventures. Even if a large market for short-haul STOL aircraft was perceived, neither the manufacturers nor the users would presently be in a financial position to develop and use them.

Another constraint which has recently arisen to impede the implementation of an intercity STOL system is the *objection to airport activity in urban areas*. Within the last few years, concern for the "quality of our environment" has become highly articulate. Aircraft are especially vulnerable to criticism primarily on the grounds of excessive noise, with secondary considerations of safety and atmospheric pollution. Politicians are necessarily sensitive to vocal public objections to environmental degradation and are hesitant to oppose them, whatever the merits of arguments based on considerations that are largely economic. The net result is that the acquisition of land for STOLports near city centers, once considered only a problem of high real estate prices, is now widely perceived to be infeasible on political grounds. This is less of a problem in some metropolitan areas where airports close to central business districts already exist, but is particularly critical in New York City, which is the origin or destination of most of the passenger traffic in the Northeast Corridor. In that city, opposition to downtown VTOL and STOLports on Manhattan Island thus far has prevented any from being built or from being used extensively.

Since elected public officials are understandably reluctant to operate in the face of articulate opposition, even relatively small local anti-airport groups have

an effective veto over projects that may benefit much larger areas. There is as yet no offsetting constituency of those sufficiently interested in short-haul interurban air transportation to exert counterpressure on legislatures and governments. Although there has not been the same kind of public opposition in other cities in the Northeast, this may be due partly to the fact that no attempts have been made to establish STOLports in downtown areas in those cities. Quite possibly the opposition would arise were such attempts to be made. However, the fact that no STOLport may be built in New York that is appreciably closer to Manhattan than the existing airports does not bode well for the future of city-center to city-center air transportation in the Northeast Corridor, because of New York's key importance as a point of origin and destination.

The other aspect of land acquisition stems from the cost of real estate in cities. The price of an acre of land in a downtown business district of a major city may be as high as \$10 million or even more, and several hundred acres might be required for a 1500-foot runway, a passenger terminal and all the supporting facilities. It has been authoritatively estimated by groups favoring the establishment of a Manhattan STOLport that it might cost \$500 million including land acquisition and construction.

To these major obstacles to the implementation of a STOL short-haul system one might add others that appear to be less fundamental. For instance, it has been suggested that the absence of FAA regulations and operating procedures dealing with STOL aircraft, or, indeed, of any approved definition of a STOL aircraft, has inhibited their development. Although it is true that no such regulations have been issued, the reason appears to be that no aircraft manufacturer or airline has felt any urgent need for them in the absence of a recognizable market for such aircraft, and hence the FAA has felt no pressure to prepare them: This "constraint" appears to be a case of confusing a symptom with an ailment.

A major constraint, the inexperience of all the interested parties – the government, the aerospace industry, and the airlines – in developing and operating a new kind of transportation system can only be removed by acquiring the experience. Virtually all the "actors" in the STOL situation suggest the same basic strategy for breaking the impasse: a demonstration project in a segment of the Northeast Corridor, using available aircraft and facilities, designed to test the market, accustom the traveling public to the advantages of STOL service and accumulate the economic and operational data required to make a decision about its extension. Naturally the details of how this demonstration would be conducted vary depending on the interests of each advocate. Some suggest that the project be federally funded, others that the promotional expense be borne by the airline and aircraft manufacturer selected. Some nominate one or more commuter airlines as the best agencies to manage a demonstration; others point out the management deficiencies, financial instability and lack of widespread public

acceptance of third-level operators and assert that a trunk line in which the public would have confidence would be a better choice. Some parties seek one or more "interim" STOLports to test the concept and gain a foothold; others are willing to concede this battle and operate from existing airports. One body of opinion suggests the initiation of STOL service employing the widely-used Twin Otter; a counter-argument is that starting out with a small, cramped, low-performance "Mickey Mouse airliner" may be the best way to kill the service before it has been tested fairly.

Based on an extension of present trends, this demonstration effort could take the form of a limited trial on a particular route — which might or might not be in the Northeast — using available VTOL or STOL aircraft. The advantages of this course are that it accepts the extreme difficulty of implementing a full-blown STOL system in the present constrained economic environment, allows time for the traveling public to become used to a new service, permits the collection of economic and operating statistics and allows the assessment of local reaction to STOLport operations. The economic feasibility and detailed operational requirements of an eventual large-scale system will be more realistically understood. The pace will be evolutionary and mistakes need not be prohibitively expensive. However, there are a number of possible pitfalls to set against these advantages. One is that aircraft available for a demonstration are not representative of what an eventual short-haul system would require. The Twin Otter is not a true STOL aircraft, and not even its most enthusiastic proponents could claim that it has the inherent passenger appeal likely to divert traffic from larger, more comfortable aircraft. Another potential difficulty lies in the fact that no STOLports presently exist outside of special runway areas at some airports, and the demonstration may lose some of its potential impact if it is perceived as just another kind of airplane operating from existing airports. These problems must be thought through in advance. If the demonstration is to be done it must be done well.

A more ambitious option would call for the Federal Government to develop an intercity air transportation system policy and long-range plan along the lines of the National Highway Development Plan. This could provide Federal funds for land acquisition and STOLport construction, eminent domain proceedings where necessary to obtain the land, and Federal R&D funds to develop the aircraft. Although such a program obviously would cost several billion dollars only for the Northeast Corridor, it could be spread over enough time so the outlay in any one year would not be unduly high. The major disadvantage of this option is that it might be too visible at a time when the government is enforcing austerity in other sectors of the economy, and fall victim to political pressures.

GENERAL AVIATION

1. INTRODUCTION

General aviation comprises those elements of U.S. civil aviation which are neither certificated nor supplemental air carriers. It includes the commuter airlines, private "pleasure" flying, corporate air transport, manufacturers of business and utility aircraft, the unscheduled air taxi operators and fixed base operations.

These groups together constitute an important segment of civil aviation. In dollar terms alone, their effect is sizable. Annual sales of new aircraft to general aviation users total over \$750 million; annual fuel sales add an estimated \$500 million, bringing the total well above one billion dollars a year without considering maintenance, insurance, landing fees, and other costs.

The user groups that make up general aviation each represent distinct, and sometimes conflicting interests, and the constraints that they perceive as blocking achievement of their aspirations vary markedly. Indeed, perhaps the only two characteristics these groups share are the relative lack of public recognition which each element suffers in relation to the air carriers, and the powerful political impact which they wield within the civil aviation community.

2. COMMUTER AIRLINES

The development of economical commercial air transportation service to smaller communities is an area where a commonality of interest exists between the air carriers and general aviation which transcends the conflict of parochial interest groups. The air carriers prefer to concentrate on long-haul operations, while commuter carriers aspire to develop profitable short-haul operations using equipment specially suited to that purpose. Constraints to more rapid progress in exploiting the potential of this situation are considered here.

The commuter airlines are small carriers generally referred to as "third-level carriers" to distinguish them from the fully certificated trunk and local service carrier industry. They operate largely on a scheduled basis, carrying short-haul passenger traffic. Operations are currently typified by flight times of less than two hours, peak schedules during the morning and evening business commuting hours, and the use of small twin-engine aircraft qualifying under the 12,500 pound exemption from route and rate regulations.

There are approximately 200 commuter air carriers in the United States — of which only four or five appear to be profitable. These airlines are increasingly providing service over the short routes and to the smaller, outlying communities.

This service has been provided historically by the trunks and regional carriers. With the advent of high-capacity, long-range jet aircraft, the certificated carriers have found it increasingly uneconomical to service small communities and intermediate points over short route segments, and are trying to drop these portions of their routes. Commuter airlines see their opportunity in filling this gap in service, but face severe obstacles to profitability, success, and effective operation. These barriers include: lack of federal subsidy or direct federal assistance during the formative phases of development; severe competition within the industry; investor disenchantment because of past poor performance and consequent difficulty in obtaining financing; vulnerability to local politics and pressure groups; and, *because of marginal financial status, difficulty in remaining profitable in the face of added costs of increasing regulation.*

a. Subsidies

Under Section 406 of the Federal Aviation Act of 1958, subsidy-eligible carriers are required to hold a certificate of public convenience and necessity. The commuter air carriers do not, in general, hold certificates. They are exempted from the regulatory and reporting provisions of the Act, and by this exemption are also ineligible for subsidy. Presumably, they would qualify for subsidy if they met the requirements for certification.

Under Section 410 of the Act, the CAB is empowered to approve or disapprove any payments or subsidies – except those made through the Commerce Department – by any government department or agency to the carriers. No such loan may be made without the approval of the CAB. Section 410 may permit the carriers to secure loans or subsidies from other agencies with CAB approval – but at present it is not being used.

Among the costs of increasing regulation is FAR Part 135.54. Promulgated approximately a year ago, it requires a flight attendant for aircraft carrying over 19 passengers.

The regulation governing flight attendant requirements (FAR Part 135.54) for aircraft operating under FAR 23 is typical of the added costs of increasing regulation. A seat must be given up for the flight attendant, the flight attendant must be paid, and indirectly, aircraft having optimal seat capacity to meet peak passenger demand are thus discouraged from being built – even if they could be within FAR 23 weight limits. One result of this is that Twin Otters, for example, are deliberately not being used to capacity in some cases. Similarly, one commuter airline is considering purchasing six Metros manufactured by Swearingen; there is now considerable doubt whether these aircraft will be purchased in view of FAA's recent ruling that any aircraft with 19 passengers or more must have a stewardess.

Because of the present marginal financial status of most commuter operations, and the increasing pressure by certificated trunk and regional airlines to drop uneconomical short-haul or secondary routes, it is reasonable to suppose that if nothing at all is done, scheduled service to many of the smaller cities and outlying communities with airport facilities will become increasingly poor.

At present, a trend appears to be emerging which may help alleviate the problem somewhat. This is the provision of secondary subsidy by the major carriers.

Secondary subsidies, direct or indirect, by major carriers are emerging as the trunk and local service airlines attempt to drop unprofitable short routes whose markets cannot economically support the large, new jet equipment. Accordingly a few of these carriers are, in one way or another, subsidizing small third-level operators to provide the service which they themselves want to give up. An example of this is the Allegheny program. Allegheny was established in the late 1940's under CAB certification as an airline serving smaller communities. The initial concept of the airline had been to originate flights at a major airport such as Washington National and stop at various communities (e.g., Frederick, Hagerstown) to pick up passengers en route to another major city such as Pittsburgh. It has become uneconomical to make these frequent stops in Allegheny's jet aircraft, a situation which became increasingly acute as upgraded equipment, increased capacity and increased costs required higher numbers of passengers. Thus, it was in Allegheny's interest to discontinue this kind of service which had been subsidized by the federal government from the outset. Accordingly, Allegheny asked the CAB for a ten-year temporary suspension of its operating obligation to various smaller communities. The airline explained that its commuter "replacement service" program would be put into effect to maintain the service that Allegheny was giving up.

The CAB, apparently aware that other carriers were following the same pattern of attempting to drop service to smaller communities, encouraged the Allegheny program which includes the following direct or indirect subsidies and other assistance:

- Complete operations under the Allegheny name (including printed schedules, etc.);
- Reservations and terminal facilities supplied by Allegheny.

In applying to the CAB for permission to drop service to a particular area, Allegheny guaranteed that the local areas would have the same CAB-approved fares. Frontier and United also are reported to have programs in support of the third-level carriers.

Whether this trend toward contracting unprofitable short-haul routes to the third-level carriers will continue is in some question, since the Airline Pilots Association (ALPA) has taken the position that “the routes belong to the pilots, not the airlines” and that the pilots must therefore be paid whether they fly the route or not. This has delayed Mohawk from farming out routes to Executive Airlines in the New England area.

b. Unavailability of Suitable Aircraft

Commuter airlines seek an aircraft that will be free of today’s regulatory and technical constraints on growth and profitability. They see a need for a commuter aircraft that has a capacity of 25-35 passengers to meet peak-load demands, that can be operated efficiently in high- as well as low-flying areas. The unavailability of proper equipment matched to commuter operations is most often translated by the operators themselves in terms of the 12,500 pound weight restriction, which makes it impractical to design and develop a machine of the required capacity and performance to meet commuter needs. An aircraft under 12,500 pounds for certification must be built to FAR Part 23 standards. An aircraft over 12,500 pounds must be built to FAR Part 25 standards which make it more expensive, heavier per pound of payload, and require the operator to meet certification requirements which impose additional costs.

If an aircraft exceeding the 12,500 pound all-up weight limit is not built to FAR Part 25 standards it will not be certificated by the FAA — regardless of any CAB action to give aircraft over 12,500 pounds an exemption to operate without CAB certification. So far the CAB has given aircraft under 12,500 pounds the authority to operate under Part 298 with an automatic exemption from certification requirements, and has made increasing exemptions for aircraft exceeding the 12,500-pound limit.

Typical of the differences between Part 23 and Part 25 standards are the following:

- Under Sub-Part C (structure) of Part 23, proof of structure is far simpler to establish than under the corresponding requirements of FAR Part 25.
- The fatigue test requirements of Part 25 involve extensive engineering and development costs for which there are no comparable requirements under Part 23.
- The same general comparisons apply to the standards for flutter, landing gear and other subsystems under Part 25 compared with Part 23.

- Under Part 23, windshields and windows require nonsplintering safety glass, and must be appropriately designed to withstand pressurization and operation at altitude. Part 25, however, imposes the additional requirement under Paragraph 25.775(B) that “windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane’s flight path) is equal to the value of V_C , at sea level, selected under Paragraph 25.335(A).”
- Under Part 23, there is no set of standards which must be met for hydraulic systems and components, while Part 25 has detailed requirements for carrying out functional tests, endurance tests, and the like, including testing in an actual aircraft or a mock-up installation.

In any case, the differences between building an aircraft for certification under Part 23 (less than 12,500 pounds) and Part 25 (over 12,500 pounds) lead to a more expensive aircraft because of the added engineering/development costs in the additional requirements imposed on the hardware; and also make the airplane heavier per pound of payload carried. Thus, the Swearingen Metro which is within the 12,500-pound limit and is built to Part 23 standards has a payload of roughly 4,500 pounds, while the next heavier aircraft – the Lockheed Jet Star – built to Part 25 standards, has a payload of only about 3,700 pounds.

Not all operators believe that the 12,500-pound weight restriction alone is responsible for the lack of appropriate equipment. Many are aware that, even if the restriction were to be liberalized, there would still be substantial obstacles to overcome, such as:

- The lack of a sufficiently large market to justify the R&D development costs involved, and to provide an attractive opportunity to the aircraft manufacturers.
- The inability of most commuter operators to finance higher performance, higher capacity aircraft built to operate under “airline” conditions.

Nevertheless, the commuter airline operators as a whole believe that lack of appropriate equipment is a major barrier to their success and growth, and they are aware that the central constraint is a financial one – whether it stems primarily from the 12,500-pound limitation, or from the fact that neither they nor their traditional suppliers can clearly justify the cost of developing and supporting the needed equipment.

Regulatory ease of entry into the third-level carrier business, together with the relatively modest initial financial requirements, may contribute to high business failure rates.

The generally poor state of the economy and tight money make it difficult to obtain financing. When even large stable trunk and local service carriers show decreased profits, low profit and earning ratios, and dwindling load factors, it is difficult to stimulate enthusiasm within the investment community for the smaller, more risky commuter operations.

A year or two ago, investments in commuter airlines were highly touted by the financial community, and stocks became inflated. Promoters and "gunslingers" oversold the commuter airline industry generally. The combination of poor management, lower-than-expected air traffic, and the general stock market decline resulted in some investment experiences which have increased investor resistance.

Lack of good management within the commuter airline industry, leading to unprofitable operation has also been damaging. Poor management judgment has been reflected by such things as: the use of inappropriate equipment due to prestige motivation, poor planning, or unrealistically perceived needs; lack of uniform trade practices resulting in line interface problems in ticketing and baggage handling; unrealistically low pricing, resulting in cash flow problems.

c. Lack of Route Protection

The commuter airlines do not enjoy the route protection advantages of the certificated local service and trunk carriers. The commuters see this as a real deterrent to profitability and growth. Once a market has been developed and a route shown to be economically viable by a pioneering operator, there is a tendency for the route to become oversaturated with competitors. The result is often dilution and dispersion of the available business among competing airlines to the point where none of them can operate economically; service deteriorates as a result. Several states, notably California and Illinois, provide some route protection on an intrastate basis. However, this sort of protection is limited, since the geographic placement of routes and city pairs offering attractive commuter markets commonly requires interstate operation.

To some extent, an increasing number of interline agreements between the commuter airlines and the local service carriers is helping to protect the "pioneer" commuter carrier on a route. As arrangements to facilitate the interchange of passengers develop it will become increasingly difficult for traffic to be raided by newcomers to a route. The problem of traffic raiding is presently a serious one, however.

The example of two midwest commuter airlines who attempted to share the Elkhart, Indiana/Chicago- O'Hare traffic resulted in the pioneering airline that developed the route being forced to drop service because the economics of sharing could not support both lines.

The entry of a second commuter carrier serving the Detroit/Cleveland market in which one had developed the route to a profitable level, has resulted in decreased schedules between Detroit and Cleveland. There is some question as to whether the original market developer will be able to remain in service unless it can establish a new source of financing.

In New England, Executive Airlines has requested the CAB to provide route protection where commuter carriers have replaced certificated airline service. The carrier has asserted that it cannot "prosper and grow in an atmosphere of freedom for others to snip away at its traffic. Route protection in replacement markets is required now and the Board must consider limited route protection for all commuter carriers."

Among the other problems of the commuter air carriers is their feeling of isolation from the mainstream of airport activity and airport planning. In many cities, the commuter airline operators have little or no part in planning airport facilities. Commuter carriers are often separated from certificated carriers in the airport complex, e.g., Chicago, Los Angeles, and Washington National, and are thus required to service their passengers through separate facilities from those used by trunk and regional operators. The result is that passengers must travel relatively long distances on foot or by taxi to make connections. In addition the commuter airline is prevented from close identification with the national and international air transport system. This, in turn, has an adverse effect on load factor and militates against the overall advantages of air travel at all levels. At present it appears that Los Angeles plans to locate its commuter facilities on the other side of the field from the national and international certificated carrier facilities. Chicago's long-range plan contemplates the same approach.

An example of how this separation can adversely affect an airline may be noted in the case of North Central, which originally had space in the Old South Building at Midway Airport. Initially, most of the other large carriers were also located there, but when the new terminal building was built, it took a long time for North Central to obtain space there. They finally managed this, however, after drawn-out negotiations with the City of Chicago. Once North Central was again physically close to the trunk airlines, its load factor went up from 40% during the segregation period to between 60-70%. While this did not occur immediately, it occurred in a reasonably short time so that the effect of close proximity to the larger carriers was suggested as being a major cause.

In many areas, particularly suburban and rural ones, local conservationists and anti-noise/anti-pollution groups have been quite effective in inhibiting the growth of commuter service. As a result of their activities, local governments and city councils will not vote funds for needed facility improvements, or for expansion of facilities necessary for additional services. Several examples from recent California experience illustrate the importance of environmental issues:

- Air California is certified to service Long Beach, but cannot get the Long Beach city council to take affirmative action on needed leased facilities. Hence, certification to operate here is useless. The reason for this opposition is public reaction to added jet noise and pollution.
- In Orange County, more than 600,000 passengers per year are serviced by an airport which was designed for 300,000 people per year. The county will not spend money on enlarged or improved airport facilities until the anti-pollution opposition is adequately countered.
- The north runway at Los Angeles International Airport was built with only modest clamor. When it was first used, however, the objections were so loud and strong that the Los Angeles City Council finally voted to buy 625 houses in the area from the owners.

d. Possible Solutions

It is widely felt that new rules and regulations are needed based on better understanding of the needs, objectives and requirements of the commuter airlines and the market they service; more flexibility and less arbitrariness are desirable in the application of rules and regulations once made. While many operators articulate a desire to repeal the 12,500-pound limitation, this is not viewed as an end in itself, nor as a refutation of sensible regulation — rather, the feeling is that commuter operators have a unique set of operating conditions and objectives, and are sufficiently important to the civil aviation complex to deserve more detailed attention to controls and restrictions imposed on them. They consider the blanket imposition of regulations designed for other types of operation in other environments with other needs a disservice.

In connection with the growing complexity of the commuter airline industry, more formalized financial reporting requirements should possibly be instituted in order to provide a publicly available source of supporting data for the benefit of potential investors. This would have the added benefit of requiring the commuter operators themselves — even if in rudimentary form — to develop management information systems, and operating and cost controls which would tend to improve commuter airline managements generally.

The introduction of a form of federal subsidy of the commuter airline operators is a possible means to assist them in becoming sufficiently established as a stable, economically viable element of the civil aviation complex. These carriers view themselves as being in much the same status, and as supplying much the same type of service as the present local service carriers once did. As short-haul routes grow increasingly uneconomical for the larger carriers, the commuters feel that market needs exist, that they can fill a market need, and that therefore, federal support is justified. Such support might come in the form of direct subsidies to the commuter operators to enable them to be strong enough financially to provide a market for improved aircraft and, therefore, to better justify the development costs involved; or in the funding of research and development of appropriate new equipment or both.

It may well be cheaper to subsidize third-level carriers operating small aircraft geared to short-haul route structures than to subsidize second-level carriers operating large jets which are not matched to short-haul traffic and which have not shown to be economical to these routes. Commuter airlines feel they can fill a market need more effectively than the local service and trunk airlines can with their large, uneconomical equipment.

Among other options for improving the commuter airlines' status, as previously suggested, is some form of route protection so that once a route is developed competition could be limited to a level that the market could properly support. The airlines serving this market would be protected from the intrusions of further competition, provided they met properly formulated standards of scheduling, safety and service.

The commuter airline operators would welcome regulation provided it is geared to the type of service involved and does not impose illogical and excessive limitations. The commuter airlines are striving to achieve recognition; they encourage regulation which treats them as a unique system in the airlines industry. With some form of progress in the direction of regulation consonant with the character of the commuter industry, and some associated route protection, it is likely that the financial community would be more willing to risk investment in support of the industry's growth.

3. PRIVATE GENERAL AVIATION FLYING

Another segment of general aviation includes the owners and users of small aircraft flown noncommercially for pleasure. The personal flying segment of general aviation represents by far the largest number of aircraft, and personal and instructional flying taken together account for more hours flown than business general aviation.¹ The tremendous growth of general aviation is shown in the

1. Estimated personal general aviation aircraft number about 65,000 of a total in excess of 120,000, and account for more than 5.5 million hours of flying according to *General Aviation: A Study and Forecast of the Fleet and Its Use in 1975*, FAA, 1966, Figures 1 and 2.

increase in the number of airman certificates issued — 132,900 student certificates in 1969 compared with 84,600 in 1964; and 54,600 private licenses in 1969 compared with 26,400 in 1964.

By sheer numbers the general aviation segment of flying makes impressive contributions to the economy, and its enormous growth has spawned the development of increasing numbers of terminal facilities devoted principally to general aviation activity. There are, however, several problems that must be faced by industry and government with regard to personal flying; among the foremost of these are the problems of traffic separation and control, and improving the airworthiness of flight equipment.

The Air Traffic Control Advisory Committee of the DOT has acknowledged the air traffic control crisis and has warned of the increasing danger of collision in mixed airspace. It has noted that the current use of radar and the air traffic control radar beacon system (ATCRBS) to assure separation,

has largely eliminated collisions between aircraft when both are under radar control. In recent years, however, collisions between air carriers under control and uncontrolled aircraft have averaged more than two per year. Since the likelihood of such collisions approximately rises as the square of the aircraft population, measures beyond the present use of "see-and-avoid" in portions of "Mixed Airspace" will become mandatory by 1980. Committee studies predict a collision rate of 10 per year in 1980 in Mixed Airspace (between air carriers and general aviation) unless changes are made. Furthermore, the collision rate between uncontrolled general aviation aircraft (33 in 1968) will also grow rapidly unless improved means of assuring separation are provided.²

Despite improvements in civil aviation accident rates in recent years, the record of general aviation is substantially worse than that of scheduled aviation and even worse than private automobile travel. For 1967 there were 0.22 passenger fatalities per 100 million passenger miles in scheduled air transport; private automobile travel was about 11 times more dangerous, with 2.4 fatalities per 100 million passenger miles. General aviation, by this same measure, turns out to be 7.5 times worse than auto travel, with a fatality rate of 18.0 per 100 million passenger miles. In 1968, a total of 1,725 persons died in U.S. aviation accidents, 1,374 of them in general aviation accidents.³

2. Report of the Department of Transportation Air Traffic Control Advisory Committee, Vol. 1, 1969; p. 6.

3. *Ibid.*, p. 18.

About half of aviation accidents occur during approach and landing, suggesting, as the Advisory Committee notes, the need for improved landing aids, and for pilot education. Of 6,157 general aviation accidents in 1967, a total of 3,290 occurred during landing or rollout. The seriousness of general aviation accidents is pointed up by instances in which small plane occupants kill not only themselves, but involve air carrier aircraft as well.

General aviation aircraft were involved in 85 midair collisions in the three years 1966-1968. Two of the 1967 accidents were fatal crashes with air carriers, one near Urbana, Ohio (26 killed) and another near Hendersonville, N.C. (82 killed). In the Hendersonville accident both aircraft were flying on IFR flight plans, but not under radar control.

The relative effectiveness of positive control airspace (above 18,000 feet in the Northeast and above 24,000 feet elsewhere in the United States), under which only IFR-controlled traffic is permitted to operate, indicates that general aviation safety in the future must depend upon the increased use of sophisticated avionics. At present, positive control airspace imposes an effective limitation to unequipped general aviation flyers.

In view of the serious general aviation safety problem, however, such an exclusion is not a constraint on general aviation nearly so much as it is the provision of vital protection to users of adequately equipped aircraft. Safety is not merely a matter of more regulation and more stringent requirements, however. In part it is a matter of assuring that regulations are adequate; but it also must include the enforcement of existing regulations, and in general the improvement of pilot proficiency. Among the National Transportation Safety Board's analysis of general aviation accidents occurring in 1968, for example, are 45 fatal accidents where "alcoholic impairment of efficiency and judgment" was either a direct cause or a factor. Other serious, and needlessly tragic causes of general aviation fatalities are such things as "continuation of VFR flight into adverse weather conditions" (141), "failure to obtain/maintain flying speed" (165), "inadequate preflight preparation and planning" (54), and "unwarranted low flying" (68).

It is not clear that technology can adequately deal with the problems of human error that cause accidents in the first place, but the assurance of more crashworthy vehicles is presumably one area of research and development from which users of light general aviation aircraft would benefit. Just as spokesmen for the consumer have concluded that automobile crashworthiness varies with vehicle design and can be improved above the low crashworthiness of today's equipment, so we must assume that small personal aircraft are capable of improvement.

Whether such improvements are truly a matter of R&D so much as they are of engineering is beyond our consideration. So too are the demand elasticities for safer aircraft; it may be that a safe small aircraft is well beyond the price of today's market. Nevertheless, it seems clear that better avionics, better preflight and flight procedures and better landing facilities for small general aviation users would achieve a measurable payback in terms of accidents and fatalities avoided.

There have been and continue to be concerted efforts by local and regional governments to provide airport facilities adequate to the needs of general aviation, with the same convenience of access to city centers as are provided by the major air carrier terminals. Airports like Opa Locka, Peter O. Knight (Tampa), North Philadelphia and White Plains are seeking to provide general aviation users with standards of safety and amenity comparable to the large carrier airports. State efforts, like those of Ohio, with its excellent system of county airports, are increasingly providing the flying public with alternatives preferable to using carrier airfields. Development work to permit the use of safe, inexpensive and readily available navigation and landing aids tailored to the needs of this segment of aviation seems warranted in the best interests of all aviation.

4. CORPORATE AIR TRANSPORT

This segment* of general aviation comprises aircraft owned and/or operated by corporations — largely for the transport of corporate executives and personnel on an unscheduled basis. Approximately 750 U.S. corporations own and/or operate aircraft for private transport purposes. According to the National Business Aircraft Association, the national fleet of business aircraft owned and available for lease or charter numbers 10,000, the bulk of which are multi-engine, and 1,500 of which are turbine powered.

This activity grew up in response to the need for:

- Access to smaller communities sited outside the major population centers, not being adequately serviced by scheduled airlines; and
- On-call access to airports nearest to the business transaction involved.

Corporate aircraft are justified by their ability to provide service to metropolitan centers at off-hours and to serve remote airports. Corporate aircraft are expensive, however. Their justification lies in the time savings and the convenience to corporate executives that they represent. Anything which infringes on these positive characteristics reduces justification for owning the aircraft for both emotional and economic reasons. The constraints to corporate aviation do not emerge as clearly as in other general aviation segments. This is believed to be

largely because corporate fleets do not bear the burdens of capital requirements, profitability and cash flow that are imposed upon manufacturers and commercial operators. For many companies, corporate aircraft are more of a luxury than a necessity, and not easily justifiable on an economic basis. Accordingly, such problems as the 12,500-pound rule,⁴ local restrictions on growth of service, unavailability of financing, and route protection are not relevant to these owners. Their major problems tend to center around inconvenience.

Corporate aviation does tend to believe that it suffers disproportionate inconvenience under the traffic limitation rules at such hub airports as Kennedy, LaGuardia, Newark, O'Hare and Washington National; the reservation system at the major airports is thought to undermine the flexibility which represents the basic reason for having corporate aircraft. The alternate use of satellite airports near major cities does not always solve the problem because many of these are approaching high density themselves; many lack adequate landing facilities; and executives do not like being told that they cannot go where they want. Special general aviation facilities like Opa Locka do represent an attempt to provide alternative facilities, however.

Corporate aircraft users tend to feel that the imposition of landing fees is exorbitant or unfair, and that often fees assessed on corporate aircraft are used to help defray costs of new terminal facilities which will not benefit corporate aviation. Furthermore, air carriers are thought to be favored in the landing fee rate structure. Moreover, these charges — plus traffic restrictions and diversions — are making it increasingly difficult to justify aircraft operation to corporate managements.

An example of landing fees that corporate users consider unfair are those imposed by a Pacific Northwest area port commission. Air carriers are assessed 55¢ per 1,000 lb, whereas corporate aircraft must pay 65¢ per 1,000 lb. The program is aimed at helping to defray the cost of constructing new terminal facilities — but the corporate aviation people feel they will not benefit commensurately, if at all, from these new terminal facilities, and that accordingly, they should not have to pay higher fees than the carriers.

5. BUSINESS AND UTILITY AIRCRAFT MANUFACTURERS

These are the manufacturers of aircraft serving the general aviation field. They manufacture planes ranging from small single-engine craft to twin-engine turbojets and turboprops. These companies include such firms as Cessna, Beech, Piper, Swearingen, and Grumman. Most are active in attempting to bring out improved equipment developments, with the smaller companies tending to be more innovative than the larger, better-established ones.

4. As in the case of commercial air carrier aircraft weighing over 12,500 pounds, corporate aircraft must be built according to FAR 25 (since the manufacturer does not know when he builds the plane whether General Motors or a certificated airline is going to buy the aircraft); if the aircraft is to be used at all for hire, it is subject to the maintenance, operating and equipment rules of FAR 121 as are the certificated carriers. If, however, the aircraft is to be operated and owned solely by the corporation or owner, he must, in general, only comply with FAR 121 as it related to such things as required electronic and avionic equipment for operating in the airspace — he does not, in general, have to comply with the maintenance regulations in their entirety; here he is required to be in compliance with FAR 91 which applies to all private aircraft.

a. Major Perceived Constraints

Major perceived constraints in this sector generally differ from those of the operators, since the aircraft manufacturers themselves have different objectives. Moreover, they are viewed differently by their customers and by the public. However, there are some similarities in the area of regulatory constraints, particularly where smaller, more innovative companies, trying to bring new ideas and designs to the general aviation marketplace, are concerned.

The smaller companies tend to be more innovative than the larger, established ones because innovation is often the only reason these smaller companies are in business, e.g., Helio Swearingen, and Lear Jet. The older, larger and more established companies are less likely to bring out improvements which represent a substantial change from their traditional designs, modes of operation, and way of doing business.

The business and utility aircraft manufacturers appear to be divided into two groups with regard to constraints which they perceive as being most severe. The large, well-established companies appear to consider legal constraints, such as increases in liability, to be of major importance; the smaller, more innovative firms tend to attach more importance to regulatory restrictions.

In recent years the number of liability suits against light aircraft manufacturers has increased dramatically. As a result, costs for liability insurance have grown to the point where they approach a significant portion of sales. One manufacturer, for example, estimates that it spends 1.5% of sales on product liability insurance – a figure resulting from the increasing extent of liability suits against aircraft manufacturers. A third-level operator in Salt Lake City now pays liability insurance of \$70,000 per year in premiums (up from \$17,000 per year when he began a few years ago) as a result of litigation increases.

Not only do these increases in liability-related costs add a financial burden which detracts from internal R&D investment, but the litigation that results from claims often causes a drain on management, engineering and clerical resources which adds to overhead costs. In addition, the potential liability implications of recent rulings result in a conservative approach to new technology and new designs, and a tendency to stay with proven designs and systems. Moreover, the apparent growing sensitivity of the FAA to liability suits has led to even stricter rulings from this agency, with a concomitant tendency to increase costs.

The industry has limited funds for research and development projects, even in profitable times. Accordingly, with internally-funded developments, these companies must be highly selective in their choice of programs, and must see a sufficient market to justify investment in any new designs. The high cost of

developing an aircraft design that uses new technology, and will also meet the requirements of the FAA for certification, is part of the problem. Manufacturers are slower to make substantive changes in their designs since these are likely to require large investments in research and development costs to meet the certification requirements of the FAA. The manufacturers almost uniformly appreciate the need for regulation, but feel a number of shortcomings exist in the present system. Among these problems of regulation are the following:

- There is the belief that communications between the agencies and the industry are inadequate to insure that regulations are necessary, effective and enforceable. For example, it has been the experience of some aircraft manufacturers that all regulations are not clearly necessary and their effectiveness is in some doubt — for example, the requirement for a flight attendant on Part 23 aircraft with more than 19 passengers; most of these aircraft (with the exception of one or two like the Skyvan) are so built that a normal person cannot stand up straight to walk up and down the aisle, as a flight attendant would presumably do in the pursuit of his/her duties.

Other examples of regulatory confusion include the requirement that the FAR 25 aircraft operating under FAR 121 have one attendant at the nine passenger level; yet FAR 23 aircraft do not require one until the 19 passenger level.

Another example of inefficient communication and divergence of goals between the agencies and the industry relates to the arbitrariness of the regional offices of FAA — one operator in the Midwest was told by the local FAA man that he must put an additional seat in some of his aircraft so that the FAA inspector could sit down during inspection flights; when he objected to the addition of this seat in his Beech 18, he was told that he did not have to put the seat in the Beech 18's, just in the DeHavillands and Grummans. Evidently, the ability to force an operator to incur this kind of expense on such a whimsical basis is part and parcel of the powers given to the FAA regions. Similarly, Helio went through a long period of testing and investigation to get the FAA region in the Northeast to certify an aerodynamic modification. Between the time the original tests were made and FAA acceptance was obtained, and the time when Helio began to install this modification on its production aircraft, personnel in the regional office had changed, and the new people refused to certify the modification — despite the FAA clearance received previously.

- There appears to be a lack of adequate agency personnel to carry out agency missions effectively. Primarily this centers around the lack of sufficient agency personnel to administer the mandates and responsibilities which they are given in the regions. The result is a lack of willingness to make decisions — particularly where these decisions involve some individual judgment or application of guidelines which are not expressly written down.
- Some rules generated in the earlier days of aviation, such as the 12,500-pound rule, tend to inhibit the development of needed new aircraft.
- Regulations regarding the modification of aircraft by other than the manufacturer are insufficiently stringent, and cause accidents which are damaging to the industry and to the reputation of manufacturers.
- The regulatory agencies are understandably reluctant to make changes in regulations which allow the introduction of new developments, since these changes would imply taking risks not consonant with the agencies' traditional regulatory and policing philosophy. There is an incongruity between the philosophy and outlook characteristic of an agency whose mission is heavily regulatory and safety-oriented, compared with those whose mission is largely innovative or conceptual in nature. The introduction of new developments implies risk and means a lot of work in getting these innovations properly tested and fitted into the regulatory and safety framework.
- The regulatory agencies can be arbitrary in their decision-making; they delegate too much responsibility and power on such matters as certification to local and regional personnel. The case of Midwest Airlines and the arbitrary requirement that a seat for the inspector be installed in some aircraft and not in others; and the case of Helio, where a change in regional personnel resulted in the negation of expensive developmental work related to an aircraft modification illustrate this point.
- There is no effective "court of appeal" to adjudicate conflicts between innovators and the regulators. While there may be a mechanism through which conflicts between the regulatory structure and the needs of the operator and user, are adjudicated, the existence of a dispassionate and nonpartisan body

is not clear. Obviously, to attempt regular adjudication through the courts themselves is cumbersome and costly. In point of practical fact, the power of the FAA is considered binding.

Increasingly, the research data developed for general aviation types of operations have diverged from those associated with high-volume scheduled passenger transport, where performance envelopes are modest. With the advent of STOL, an additional set of constraints specifically oriented toward the civil field is imposed — the aerodynamics and behavior of configurations which will permit steep glide slopes, short roll-outs, and short takeoffs combined with high payloads and high speeds have not been developed. No one knows how many of these configurations will really behave. Military aircraft which perform in the STOL mode are in many ways completely unsuited to passenger operations — it is doubtful whether a great number of passengers will repeatedly choose to ride in a Helio Courier, for example, at the climb angles required to get it off the ground.

b. Possible Solutions

- Manufacturers would welcome an increase in government-sponsored research and development aimed specifically at civil aviation and general aviation needs, as opposed to technological spin-offs from military research and development efforts. Study efforts documented elsewhere have brought out the historic orientation of government-sponsored research to military aviation and aeronautical requirements. Originally, the research done on certain classes of military aircraft was applicable to certain components on civil aircraft. Over the postwar years, however, military aircraft have been increasingly sophisticated as to their aerodynamics, propulsion and avionics. Military emphasis has been placed on such areas as supersonic configurations capable of operating at high altitudes, launching ordnance at high speed, landing on carrier decks in foul weather, and withstanding high extremes. This technology has limited, if any, applicability to general aviation.
- The 12,500-pound limitation on certification under the light aircraft rules should be relaxed to enable the development of new aircraft for commuter airlines within practical technical and cost constraints.
- A review of the liability of manufacturers should be undertaken. In cases where an aircraft no longer clearly comes under the responsibility of the original maker, attempts should be made to remove some of the liability burden from the manufacturers.

6. AIR TAXI AND FIXED BASE OPERATORS

a. Air Taxi

These operators – like the commuter airlines – operate light single-engine and twin-engine machines within the 12,500-pound limitation, and often operate between city-pairs.

Unlike the commuter airlines, however, they operate on an unscheduled basis and they may travel over longer routes and to those points not serviced by scheduled carriers. In most other respects the problems and possible solutions applicable to the commuter airlines hold equally for the air taxi operators.

b. Fixed Base Operators

These are the operators of support services and facilities for the general aviation complex. They perform a number of services, either singly or in combination, such as maintenance and repair, training and flying schools, fueling and routine servicing, etc. They also may act as dealer/distributors, spare parts suppliers and maintenance stations for the business, pleasure and utility aircraft manufacturers.

Many fixed base operators are marginal, undercapitalized, and lacking in managerial skills. The failure rate of these businesses is very high, and there is some trend toward consolidation, in which the smaller operators merge with the larger ones to provide stronger entities. Many operators are not concerned with what is happening to the industry as a whole. This part of civil aviation has no powerful association as its spokesman, and for this reason lacks the common objective and general consensus required to perform successful public relations programs and promotions.

AIR CARGO

1. INTRODUCTION AND BACKGROUND

Air Cargo is a second-order victim of the air carrier industry's preoccupation with passenger service. It is a thirty-year-old infant that continues to offer great promise in the long run, but which has been hampered by managerial, technical and economic problems over its entire lifetime.

From a managerial and regulatory viewpoint, government and industry have never been able to agree whether cargo is part and parcel of passenger operations, or whether it should be a separate entity. The result has been a stifling of cargo interests among the combination carriers — they simply have too many other problems. An attempt by government to give cargo the undivided attention it may need — the creation of all-cargo carriers — has not been spectacularly successful because the all-cargo operators have never been unleashed from constraints of limited routes. They have therefore led a "constrained and wraithlike existence," in the words of one observer.

Despite the rapid growth of the air cargo industry over the past decade, many problems are unresolved. An estimated eight billion ton-miles of cargo moved in scheduled and non-scheduled world services in 1968¹ with U.S. carriers accounting for about 60% of the total.² U.S. domestic air cargo represents less than one-fifth of one percent of total intercity freight ton-miles,³ however, and is minimally profitable, at best. Because of the lack of profitability there is little likelihood of meaningful rate reductions. More significantly, it is unlikely that either all-cargo operators or combination carriers will be induced to buy new cargo flight equipment. The Boeing 747F and the L-500 are both in jeopardy.

Air cargo has been a stepchild, treated economically and operationally as a by-product of passenger transportation in order to achieve more economic use of tubular aircraft fuselages. Air cargo commodities still have exceptional characteristics such as high value, perishability or "emergency" requirements rather than belonging to a broad class of goods shipped by air as a matter of normal business procedure. The combination of these characteristics has made it difficult for operators to make profits, and this, in turn, has restricted investment.

1. *World Air Transport Statistics*, International Air Transport Association, 1968.

2. *Air Carrier Traffic Statistics*, Civil Aeronautics Board, Dec. 1968, p. 1.

3. *Transportation Facts and Trends*, Transportation Association of America, April 1969, p. 7.

2. AIRCRAFT CONSTRAINTS

Technical problems stem from the aircraft in use for all cargo operations and from the constraints imposed on the cargo operations in combination aircraft. The aircraft presently in use were not built for cargo service — they are cargo adaptations of passenger aircraft, such as the DC-8. Since the CL-44 and the Argosy, no civilian aircraft has been designed for the cargo market for several reasons. First, there have been limited markets for air cargo because of the high total costs compared with surface transportation. And, second, there are limited economies for improved vehicle design, since a large portion of total air cargo costs is in ground handling.

Because aircraft operated in all-cargo configuration were primarily designed for the carriage of passengers, their cargo-carrying capacity is generally volume limited; that is, the fuselage will be filled while the aircraft could still carry more weight if the space were available.

Passenger aircraft are further limited by the size of the cargo loading doors and the bearing strength of their floors. With very few exceptions their floors are much higher above the ground than the floor of a truck, thus complicating the transfer from one mode to another. Finally the circular shape of the passenger aircraft fuselage forces a configuration on loads which does not match the square cross section of truck bodies.

These are the major deficiencies in the all-cargo aircraft today, and the current generation of freighters, being relatively new, are likely to be with us for at least five more years. In 1969 three all-cargo carriers took delivery of their DC-8-63F's. These stretched aircraft have proved to be much more efficient, and economical, than their predecessors, the 707-320C's and the DC-8-50F's. However, it is still difficult to prove that today's all-cargo operations offer attractive profit possibilities.

One of the reasons for this lack of profitability is the high operating cost of the aircraft compared with a long-haul truck or a container ship.

Although there are two nominal contenders for the next generation of all-cargo aircraft, neither is entirely satisfactory. For example, the L-500 has a relatively low cruising speed because of its large cross section and high wing, which reflects its military antecedents. Although speed is less important in cargo than in passenger service, this low speed is a significant factor.

The containerized payload of the L-500 is about 130 tons, compared with about 55 tons for the DC-8-63F. Comparative direct operating costs per available ton-mile are 2.5¢ and 4.0¢ respectively. So far the greatest interest in the L-500 has been shown by shipper groups considering private carriage, and not by airlines.

Although the 747F is much closer to reality than the L-500, sales have been very slow. It is understood that the two all-cargo orders will be honored, as will the two convertible versions, but there is no strong airline interest in this aircraft at the present time. The 747F is partly compromised by its passenger antecedents, as the L-500 is compromised by its military heritage. The 747F can carry 112 tons in standard containers in the main cabin, and in crescent-shaped containers in the belly holds. The payload is thus less than that of the L-500, but its speed is higher. Some airlines complain that the system for stowing the last two containers in the nose of the 747F, where they have to be positioned diagonally, is impracticable. The direct operating costs per available ton-mile for the 747F are about 3.2¢.

Other constraints are deferring the introduction of the next generation of all-cargo aircraft. The current slump in airline profitability, at the very time when major deliveries of new passenger aircraft are in progress, has placed a heavy burden on airline capital budgets. Since air cargo has not generally proved to be a major contributor to airline profits, its priority is understandably low. The all-cargo carriers, having just reequipped with stretched DC-8's, are in no mood to commit to another fleet reequipment cycle.

Moreover, the aircraft manufacturers are in no financial position to start production of a new line whose prognosis for breaking even, let alone generating profits, is remote. (Sixty L-500's operating at 50% load factor could carry all the air freight moving in the entire free world today.)

McDonnell-Douglas, for its part, has no firm plans for a next generation cargo aircraft, but is refining a number of configurations generally referred to as the C-2, C-4 and C-6 family. Supposedly "uncompromised" by either military or passenger origins, these aircraft could not enter service before the end of the seventies. The gamble is that industry will wait for these aircraft because they are not ready for the "compromised" competitors at the present time. The hope is that profitability will have improved, and the market will have been further developed, by the time the McDonnell-Douglas aircraft are available.

The development of the market is a further major factor that imposes a constraint on the production of an advanced technology all-cargo aircraft. Most of the cargo to be carried in the next generation aircraft will move in modified forms of the ISO 8' x 8' x 20' container. The fuselages will be configured to accommodate these containers, and the high-cost terminal operations will be reduced by the unit handling of these large loads. But at the present time, very little cargo indeed moves in the 12-ton lots needed to fill a 20' container. In fact, a very small percentage, perhaps 5%, currently arrives at the airlines' docks in the smaller "igloos" used in today's aircraft. These igloos typically hold only about two tons. In the case of most commodities, air rates are still too high to attract the entire

shipment, so the airlines are handling very small shipments. Today, the combination carriers' average shipment weight is estimated at just over 100 pounds, while the all-cargo carriers' shipments average 400 pounds.

Thus, the problem of establishing a profit potential becomes self-perpetuating: large-unit air shipments are necessary to reduce costs, but until tariffs are substantially reduced, such shipments are not economical for the shipper. Until this problem is resolved, the airframe manufacturers do not see a big enough demand for their aircraft to justify production.

Further constraints on new aircraft production for cargo operations of the combination carriers and all-cargo carriers are economic ones, the result of pricing mechanisms required under regulation, and the result of the small shipments problem that keeps costs high. The combination carriers have substantial cargo capacity in the bellies of passenger aircraft, and need to utilize this capacity to provide marginal revenue contributions on passenger flights. Yet the cramped and awkward spaces are not conducive to efficient loading and unloading, and the efficiencies of the aircraft direct operating costs are thus lost in ground handling. In addition, the point-to-point passenger markets are not necessarily good freight markets. The enormous belly capacity of the Boeing 747 will help relieve some of the space constraints on these carriers, but it does nothing for market constraints. The all-cargo carriers, on the other hand, are constrained more by the size of the aircraft and route limitations than by availability of markets, since they are not bound by passenger markets. Since cargo capacity of the combination carriers is developing so rapidly, the all-cargo operators face strong competition for traffic.

There is a substantial policy issue at stake involving whether the separation of cargo carriers and combination carriers is valid. On the basis of wide-body aircraft designs like the Boeing 747 and the DC-10, the combination of passenger and cargo operations performed by the same vehicle is likely to continue. Despite the hope that the L-500 could be the vehicle that makes economic private and contract carriage possible, as well as profitable all-cargo business, the growing fear is that the L-500 is ahead of its time and that demand may not materialize among the carriers.

3. INTERMODAL OPERATIONS

Intermodal operations are discussed by airlines, trucking and rail firms, but there is little action. In part this is because aircraft capable of accepting van-size containers (8' x 8' in cross section), are not in wide use. The availability of the L-500 is uncertain, and aircraft like the 707 and even the 747 are simply not built for van containers.

A further hindrance to intermodal operations is that economical packing materials are still not available to provide the strength required for rail and truck operations without incurring an unacceptable weight penalty for air cargo use. Typical rail-maritime containers weigh from 6-9 pounds per cubic foot of capacity, and economical air operations require containers in the 1-2 pound per cubic foot range. Such light containers are not economically feasible for widespread use today, and intermodal operations are severely constrained by this factor.

Perhaps the most formidable obstacles in the way of air cargo growth, however, are the modal constituencies of the regulatory agencies. The CAB carefully defines air carriers and effectively uses a separation of direct aviation operators — the air carriers — from air freight forwarders to prevent the single corporate control of the entire physical distribution process which many deem essential to air cargo's growth.⁴

Section 401(a) of the Federal Aviation Act of 1958 requires Board certification to engage in air transportation. The principal standards for granting certification, set forth in Section 401(d), are the public convenience and necessity, and the fitness, willingness, and ability of the applicant. According to the definitions of Section 101(3), "an 'air carrier' means any citizen of the United States who undertakes, whether directly or indirectly or by a lease or any other arrangement, to engage in air transportation: *Provided*, that the Board may by order relieve air carriers who are not directly engaged in the operation of aircraft in air transportation from the provisions of this Act to the extent and for such periods as may be in the public interest."

The Board thus has substantial discretionary power of its own to encourage or turn away "indirect" air carriers. Joint boards between the CAB and ICC are provided for under Section 1003, and there is clear legislative provision for CAB and ICC to study jointly "matters relating to...through service and joint rates, fares or charges." The language of the Act is permissive, however, and the result has been argument over jurisdictions rather than interagency cooperation to solve common problems.

4. See Section entitled "Legislative and Regulatory Factors" for further discussion.

Recently the Board showed some sign of relaxing its stance when it allowed three long-haul trucking companies to become air freight forwarders. One mode, the truckers, has been allowed to operate another mode, the indirect air carriers. This step was taken to infuse some capital and increased distribution outlets into the weak freight forwarder industry. It is experimental, and only one of the parties is a direct carrier.

In the other direction, however, a maritime operator was ordered to divest itself of its control of an airline, and the Penn Central Railroad was ordered to divest itself of its control over Executive Jet Aviation.

Potential benefits from mergers or other forms of intermodal consolidation include:

- One company has responsibility for the entire haul.
- The airlines would benefit from the trucking companies' experience in operating terminals. (Unit truck terminal costs are about one-tenth of unit cargo terminal costs.)
- The airlines would benefit directly from the large number of existing distribution outlets available to the trucking company.
- Joint marketing campaigns would be more effective, and information on commodity flows could be shared. (There is, even now, some sharing of market research data between the international all-cargo carriers and the trucking companies that serve them.)
- The public interest would be served through improved service.

4. LANDSIDE CONSTRAINTS

Both producers and users of air cargo services recognize that they are heavily disadvantaged by today's unsophisticated operations. Time gained in the air is lost in the terminals, and the trend to off-airport stuffing of containers is of no benefit to small shippers. Present-day air cargo users now suffer from the same problems that railroad less-than-carload (LCL) users did in the past — delay, pilferage, and misrouting. Last year's reported losses at Kennedy Airport alone exceeded \$3.3 million, with 545 cases of theft on record. A CAB sample study in 1969 revealed that 54% of the total number of shipments carried by the combination and all-cargo carriers weighed less than 100 pounds. Yet these shipments accounted for only 17% of the revenues of the carriers.

Paperwork and documentation problems abound in air cargo operations. In fact, duplicating paperwork to satisfy the requirements of shippers, receivers, brokers, domestic and foreign governments is seen as a major constraint to air cargo profitability. The problems are related in part to the predominance of small shipments in today's air cargo operations. The total cost to process papers for a 100-pound shipment is substantially the same as for a 5,000-pound shipment, but the unit cost for the former is obviously substantially higher. As long as present rate levels are necessary to approach profitable operations, the market for air-freightable goods will remain limited.

Much can be done to improve cargo documentation procedures, but success depends on the ability of international agencies to agree upon standards. Operators suggest that it is within present technical capabilities to code containers for machine reading. They further note that the same techniques that banks use in processing personal checks could be applied to keep track of containers, record their weight and contents and notify customs by data phone.

Whereas cargo services operate on a 24-hour basis, the customs service at international arrival points is an 8-hour operation. The resulting delays in cargo processing constitute a severe constraint in the flow of international commerce. Cargo operations are brought to a crawl on weekends and at night because of the absence of round-the-clock customs service. The lack of adequate inland customs clearance points is a similar obstacle seen by cargo operators. Such barriers must be removed before an efficient freight system can function at high volume. No new technology appears to be required to institute such administrative reforms.

Organizational alternatives suggested to improve the customs bottleneck include the possibility of licensing domestic receivers of goods to operate on a self-policing basis. Goods would clear customs without inspection and proceed directly to bonded warehouses where participating firms would be responsible for computing and paying customs duties on an honor system. The entire procedure would be subject to unannounced spot-checks by federal inspectors.

Producers of cargo services perceive a need for more adequate market data than is now available. The 1963 Census of Transportation (now updated to 1967 data) provides eye-opening information on cargo flows, but there is still too little data and inadequate sophistication in dealing with it.

The best and almost only sources of domestic commodity flows are the 1963 and 1967 Censuses of Transportation, compiled from the shipping documents of a wide sample of shippers. The information is processed and presented in two ways that are of some use to the carriers, but they stop tantalizingly short of being of major value. For example, the closest we can approach to true origin and destination data are the tonnages of different commodities which flow between each of twenty-five U.S. production areas.

Not all the cargo carriers, however, have made use of the market data that is potentially available from their own sources. The airlines do not yet tabulate their air cargo origin and destination information in the same way that the CAB documents passenger origins and destinations. The task of tabulating the cargo data is complicated by the fact that, whereas there are only a few classes of passenger fares — first class, coach, promotional — there are many classifications of cargo commodities. The carriers have met for years to develop air cargo origin and destination data, but so far expense and lack of agreement as to format have defeated the project.

Moreover, the carriers have also neglected to analyze their own and their shippers' costs, with the result that there is no coherent pricing policy that could be expected to increase profits at the same time as it attracts more business. The carriers do not know which commodities are profitable to them at any particular rate level. Specific commodity rates are filed more or less haphazardly, and few records are kept as to what moves at these rates once they are in the tariff. Similarly, there is little good information about the shippers' total costs of distribution, so it is difficult for the carriers to arrive at a rate that would be both attractive to the shipper and profitable to themselves.

Cargo sales and marketing remain, in brief, a complex art. Primary demand is still increasing, and shippers often find that they themselves help stimulate cargo backhauls through their contacts, and feel that carrier management should be doing more to develop traffic themselves.

The problem of air cargo thefts has recently been given a great deal of publicity. Carriers in the past have attempted to downplay the seriousness of the problem, and do not believe that it has been a constraint to past traffic growth. Airport operators away from the New York City area believe that crime is a less serious problem, and one that is subject to control. First, they assert that theft is not so much the result of organized crime rings as it is of "do-it-yourself" efforts by individuals or small groups. Second, the inadequate facilities in which most air cargo operations are conducted provide a relatively attractive opportunity for theft.

Air cargo theft cannot be wished away; it is believed that future traffic growth will be adversely affected by bad publicity attendant on the growing theft problem. Air carrier acknowledgement of the problem is required before substantive improvements can be made. And air carrier concern must go beyond mere recognition of the problem. Additional surveillance systems and tighter security measures are necessary, and some operators see the need for moving break-bulk operations to off-airport sites.

Air cargo operations are labor intensive, even before the added labor costs caused by terminal congestion and delay are included. Management predictably looks to automated terminal equipment and containerized operations for improved operating economies.

Trucking and distribution to and from air terminals on a 24-hour basis is necessary, as is the recognition that scarce airport space cannot be used for general warehousing. Off-site paperwork and container loading are seen as options to put the labor-intensive functions at a point in the distribution channel where they can be most effective. Mechanization of cargo terminals, a process of capital intensification, may then be justified.

Since many air cargo flights depart late at night, or in the early hours of the morning, the noise they make is especially annoying to the communities affected. Curfews on jet operations in the United States and Europe are severe constraints on the efficient operation of cargo flights. These restrictions affect cargo flights to a much greater extent than passenger flights because of the higher gross weights (and therefore noisier takeoffs) characteristic of cargo operations.

In the absence of satisfactory noise-dampening devices or quieter engines, the obvious alternatives that appear open to cargo operators are to shift operations to already crowded daylight hours, or to carry lighter loads to decrease noise.

APPENDICES

**SECTION II – R&D MANAGEMENT
APPENDICES A – D**

**SECTION III – LEGISLATIVE AND
REGULATORY FACTORS
APPENDIX E**

APPENDIX A

1. THE CONTRIBUTION OF FOREIGN GOVERNMENTS TO THEIR CIVIL AVIATION INDUSTRIES

The United States is unique among all nations of the world in possessing an aircraft industry which generally receives no direct government assistance for civil aviation research or development. This has only been done in the case of the SST where the required financial resources are beyond those available to any company or combination of companies.

To briefly summarize the policies of the various free world governments toward civil aviation R&D:

a. Canada

Canada's aerospace industry has been subsidized by the government for a number of years, initially to preserve it as part of a mobilization base, but lately in recognition of its significant contribution to the country's balance of trade. There are a total of six incentive programs for industry. One of them provides for grants of 25% of the cost of new capital equipment and for a 25% increase in company-funded R&D. Another is a general incentive to encourage the development of defense products ("defense" is interpreted most liberally — the Twin Otter qualified as a defense item) with export potential; this program provides Federal assistance up to 50% of the cost of development engineering, material, labor and G&A expense on new projects, and loans for up to 50% of the cost of modern production machinery, or 50% of the preproduction costs of a defense product for export. In another program, the government will contribute up to 50% of the total development cost of commercial products with high technical content; if the product is a commercial success the government aid is repaid over a ten-year period at a negotiated rate of interest. Other programs exist to encourage the expansion of industry in underdeveloped areas of Canada, and to stimulate either defense-related or commercial research in Canadian industry.

From 1963 through 1968, the Canadian government invested approximately \$94 million in support of aviation-related R&D in industry, and the resulting programs returned \$245 million in sales and firm orders during that period. One of the most successful individual programs has been the PT-6A engine family which, for \$11.6 million in Federal development assistance, has resulted in over \$100 million in sales, 60% of them export.

b. France

France has a policy of providing permanent financial assistance to her aerospace industry in order to encourage high-technology industry, maintain a

high level of exports and preserve a mobilization base. The largest single civil aircraft project has of course been the Concorde (2,800 million francs through 1968). Others include the Caravelle (560 million francs) and the Nord 262 (92 million francs). It is estimated that the annual level of direct government subsidy of commercial aviation projects was about \$175 million (885 million francs) in 1969, although it is expected to decline slowly for the next 2-3 years.

It should be noted that these subsidies are nominally in the form of loans, repayable if sufficient production, sales and profits result. Since this never has occurred, the amounts have in fact been nonreimbursable.

c. Germany

Germany supports aerospace research and development quite liberally, considering the small size of this industry, with the rationale that it is living on borrowed technology, spending more than twice as much for license agreements with foreign firms than it receives for exporting its own. In 1968 the Federal Government spent \$81 million for aerospace-related research, which will be increased to an annual level of over \$100 million by 1971. Additionally, it has furnished over \$50 million toward the development costs of the HFB Hansa, the VFW 614 short-haul airliner and the Boelkow Bo-105 helicopter, all civil projects.

d. Japan

Japan employs a variety of financial devices to assist its growing aircraft industry. One partly nationalized firm, Nihon, is 60% capitalized by the government and 40% by private enterprise. Additionally, Nihon has issued some \$57.5 million in debentures which have been underwritten by the government. The Japanese government also has supplied, in the form of loans, around 30% of the \$48 million required by the aerospace industry to buy new production equipment. A modest amount of money, some \$10 million, has been spent to fund aerospace research in the industry and some universities. Another \$7 million has been spent on preliminary design of a jet-powered successor to the Nihon YS-11 turboprop feederliner. Nihon has been supplied with low-interest rate loans (4%) by the Japan Export-Import Bank to finance export sales of the YS-11. Finally the government has spent some \$100 million in building up an engine capability through license agreements with Pratt & Whitney, Rolls Royce and General Electric.

e. The Netherlands

The Netherlands has a one-company aircraft industry embodied in the old Fokker Company, now merged with the German VFW works. A most interesting and unique government institution, The Netherlands Aircraft Development Board,

was established after World War II to guide, supervise and finance the development of aircraft in Holland. It has a permanent staff numbering only about 25, and a Board of Directors including representatives of the Ministries of Transport, Economics, Finance, Defense and Foreign Affairs, Fokker and two national research institutions. The Board evaluates and frequently initiates projects and recommends the extent and nature of government support required. In the case of the Fokker F-27 the contract provided for the financing of the entire development with no refunds due on the first 25 production aircraft. The principal sum was to be paid back, interest-free on the next 100 aircraft sold. On sales beyond 125 a smaller risk-participation premium was due the government. Since more than 500 F-27's were sold, it was an excellent investment for the government.

f. Sweden

Sweden also has a one-company industry (SAAB), but the rationale for its existence always has been national defense; it has engaged in no significant civil aircraft work.

g. The United Kingdom

The United Kingdom provides government financial support to its civil aircraft industry in two ways, assistance with R&D projects and assistance with the launching costs of specific programs. R&D support totaled around \$360 million in 1969, almost all of which was for military work. Very little support of civil aviation R&D has been directed in recent years toward the airframe industry, most of it going to Rolls-Royce as the nation's only surviving engine manufacturer. Launching cost assistance (i.e., sponsorship of development) totaled around \$140 million in 1968, \$108 million of which was for the Concorde. Assistance usually takes the form of a grant repayable out of the proceeds of sales, no loans being made as such. In general the Labor Government was unsympathetic toward civil aviation and the aerospace industry, the bulk of support going to the Concorde for reasons largely concerned with Anglo-French relations. It is not yet clear what the Conservative Government's policy is to be.

APPENDIX B

1. RELATIONSHIP BETWEEN MILITARY R&D AND CIVIL AVIATION

The case of the Boeing 747 and its power plant, the Pratt & Whitney JT9D engine, provides an excellent example of the interchanges between government-sponsored military R&D and the field of civil aviation.

a. The 747 Program

The 747 had its origin in the early days of the C-5A competition. In 1962, Lockheed won a USAF contract for development and production of a medium-size (70,000-lb payload) jet transport, the C-141. With the loss to Lockheed, Boeing proposed a new aircraft to the Air Force in mid-1963 that in Boeing's judgment would best meet the airlift needs of the 1970's. With new emphasis on cost-effectiveness, Boeing recognized that to sell the proposed new aircraft it would have to demonstrate a major increase in productivity. The best way of doing this in a transport plane is to increase its size. Boeing's proposal was convincing and the Air Force issued an SOR (Specific Operational Requirement) for an aircraft designated CX-HLS, which would be capable of carrying up to 750 troops in and out of 4000-foot unprepared strips. The technical advance that made such an aircraft feasible was the high-bypass turbofan engine which offered up to 40,000-lb takeoff thrust at weights not appreciably greater than turbojets of half this thrust and with better specific fuel consumption. These engines were pioneered by General Electric.

Between the time the SOR was written and the CDP (Contract Definition Phase) contracts awarded to Boeing, Douglas and Lockheed, Boeing undertook studies of the three principal airframe-related problems:

- A high-flotation landing gear enabling a 730,000 pound airplane to land and take off from primitive airfields.
- High-lift devices to permit maximum gross weight operation in and out of 4,000-foot strips.
- Structural design of a very large aircraft.

When Boeing's proposal went to the Air Force at the end of the CDP they felt confident they had technology well in hand and costs realistically estimated. However, they lost the competition to Lockheed who underbid them by \$300 million.

Boeing now had to make a decision about the future direction of its commercial aircraft development. They could continue looking at what were essentially stretched 707's, as Douglas was doing with the DC-8, or go to a very large airliner using their C-5A acquired technology. A number of factors led them to adopt the latter course. It is reported that Charles Lindbergh, in his capacity as technical advisor to Pan American, encouraged them to propose a large (300-500 passenger) aircraft for the North Atlantic trade. A Pan American vice president told them the airline had made a tentative decision to buy 25 stretched DC-8's. The DC-8, because of greater ground clearance, could more readily be stretched than the 707. Pratt & Whitney had developed the JT9D for the C-5A competition and, having lost to General Electric, were anxious to find a customer for the engine. Finally, Boeing's researchers forecast a market for some 600 such aircraft during the decade of the 1970's, much of it to be accounted for by major growth of air cargo. The decision was made to proceed with what became the 747, and Boeing transferred around 100 engineers from its disbanded CX-HLS study group to the new project. Within a relatively short time they had prepared enough material to sell the airplane to Pan American which came up with the first order for 25 747's. Had Boeing won the CX-HLS they would not have had the technical manpower or financial resources to proceed with the 747 program.

Prior to the time it made a firm decision to go ahead with the program, Boeing had spent about \$15 million of its own money on developing the concept of the 747. In general the Boeing people believe that, although there were important indirect transfers of technology from the CS-HLS CDP effort, particularly the high-bypass engine, large aircraft structural techniques and the high-flotation landing gear, most of the initiative and all of the money devoted to the 747 came from Boeing.

There is no "new technology" in the 747 other than the large high-bypass turbofan engine. The basic layout is essentially a scaled-up version of the B-47, which dates back to 1948. The contribution made to the 747 by DOD funds consisted of the expertise and confidence acquired by the engineers studying the problems of building a very large military transport, which was transferred to a commercial counterpart.

b. The JT9D Engine

By early 1960 Pratt & Whitney decided that the turbofan engine, as opposed to the pure turbojet, was here to stay. During this year and early 1961 the F-111 competition was going on, and in the course of it General Electric offered a completely new turbofan engine for this aircraft. Pratt & Whitney had nothing comparable; indeed, none of their turbofan engines had been designed as such. They had in development the TF30 (basically a scaled-down JT3D) which was to

be used on the Navy's *Missileer* fleet air defense fighter, and the JT8D, a turbofan modification of their military J52. The JT3D, a turbofan modification of the J57, was their principal commercial production program.

Although P&W eventually won the F-111 engine competition on the grounds that the TF30 was well along in development, GE's move threw a bad scare into the organization. They decided that P&W should develop an all-new turbofan engine so they would not again be caught short with nothing better than updated 1950 technology. In late 1961 they began the development of an engine with the company designation of STF-200. The principal applications were perceived to be the CX-HLS (which became the C-5A) and an eventual second round of airline re-equipment. The engine was to have 30,000-lb takeoff thrust, a compression ratio of 9:1 and a bypass ratio of 2:1. The structure was greatly simplified over that of the JT3D and JT8D, and it was the first P&W engine to have variable stators. They tried unsuccessfully to get the Air Force to support development of a demonstrator, then went ahead on their own money. The STF-200 first ran in 1964.

By 1964 the CX-HLS CDP was in progress, and Pratt & Whitney got two USAF contracts that helped pay for further development of the STF-200. One contract was for a study to define the propulsion requirements of the CX-HLS; the other was for experimental work and technical development of a large turbofan engine. The study led P&W to conclude that the CX-HLS would require an engine with a higher bypass ratio than the STF-200 and 40,000-lb takeoff thrust. They modified the STF-200 by installing a large single-stage fan and adding another stage on the low pressure turbine; the bypass ratio was increased to 3.5:1. This engine was designated the JTF-14. Both the existing STF-200's were so modified and were running in 1965. They had about 200 hours of ground testing by the time the CX-HLS contract was awarded in 1966.

Pratt & Whitney lost the CX-HLS competition to General Electric and found itself without a customer for the JTF-14. By now some \$40 million had been spent on this engine, of which less than one-quarter was reported to be P&W's money and the remainder the Air Force's. At this point, early 1966, P&W got together with Boeing to offer them an engine based on the JTF-14 for a commercial aircraft. They had to modify it further because the required thrust steadily grew from 32,000 to 43,500-lb and a great deal of attention had to be paid to noise suppression. This became the JT9D.

The JT9D is a significant but not radical departure from the JT3D and JT8D. It offers almost 2.5 times the thrust of the JT3D and almost 25% better specific fuel consumption. By dispensing with inlet guide vanes, adding extensive noise attenuation lining, employing a low-tip-speed fan and decreasing exhaust gas velocity, the engine is appreciably quieter than its much less powerful

predecessors. Its mechanical design is much simplified, with only four main bearings as opposed to seven or eight on earlier engines. A single annular combustion chamber instead of separate burner cans permits operation without visible smoke emission and also simplifies maintenance. As is the case with the 747 airframe no “new” technology in the sense of a wholly different principle, technique or material is used in the JT9D. But by simultaneously making a lot of comparatively modest improvements in components and overall design layout, a major increase in performance has resulted. The origins of the engine are military, stemming from Wright Field-supported R&D on high-bypass engines by General Electric followed by the CX-HLS program.

APPENDIX C

1. EXAMPLES OF CIVIL AVIATION RESEARCH AND DEVELOPMENT PROGRAMS

a. NASA (OART, Ames, Langley, Flight Res, Lewis, and Mission Analysis)

1. Technological R&D

a. Aeronautical Vehicles:

- Quiet Engine Program
- V/STOL Aircraft (externally blown flap, jet-augmented wing, lift fan)
- Advanced Technology Experimental Transport
- Supersonic Aircraft Development (Propulsion)
- Hypersonic Aircraft (Fuel-Cooled Aircraft Structure)
- Small Gas Turbine Engine (General Aviation)
- Rotorcraft Research
- Subsonic Aircraft

b. Electronic Systems:

- V/STOL Automatic Landing Systems
- General Aviation (improve handling characteristics with low-cost avionics)
- Advanced Technology (digital processing, power sources, signal sources and displays)

c. Basic Research:

- High Reynolds Number Research
- Aerodynamic Noise Research

2. Nontechnological (soft) R&D

- Study of Aircraft in Short-Haul Transportation Systems
- Time-Value Analysis of Civil Passenger Transportation Short-Haul
- Future Costs of Liquid Hydrogen Production for Use as an Aircraft Fuel
- Study, Cost, and System Analysis of Liquid Hydrogen Production
- Noise Considerations for V/STOL Transports
- Management and Allocation of Resources
- Development of an R&D Cost Synthesis Model for Aerospace Vehicles
- Development of a Manufacturing Cost Synthesis Model for Aerospace Vehicles

b. FAA

1. Technological R&D

- In-Service improvements programs
- Current systems modernization program (NAS, ARTS III) to provide a semi-automated ATC system
- Airport and Airways Traffic Capacity Program
- Airport Capacity and Airway Capacity Programs (ATCRBS, microwave 165, multiple runway techniques, etc.)
- Long distance navigation

2. Nontechnological R&D

- The Airport — its influence on community economy
- Forecast composition of National Airport System 1970-1980
- Aviation Forecasts, FY69-80

- Requirement of criteria relating to airport development grants
- Problems of airport congestion by 1975
- Study of airport expansion and long-range system planning
- Evaluation of NAS Enroute Stage A and ARTS III
- Cost effectiveness analysis of large screen displays
- VFR tower effectiveness and establishment criteria
- Cost effectiveness of Automated Radar Terminal Systems (ARTS)
- Determination of measures of effectiveness of Airport Surveillance Radar (ASR)
- Benefit-cost analysis of ARTS III system

c. Office of Secretary of Transportation

1. Technological R&D

- 4th generation ATC system requirements and specifications

2. Nontechnological R&D

- CARD PS Study
- Transportation Planning Simulation
- Environmental factors in airport site selection
- Environmental effects of Miami Jetport
- National Transportation Needs Forecast
- Northeast Corridor Transportation Demand Forecast

d. CAB

1. Technological R&D

None

2. Nontechnological R&D

- Study of the problems of airport congestion by 1975
- Regression study of the demand for air travel in the United States
- Forecasts of the growth of scheduled domestic passenger air traffic — domestic trunk airlines
- Study of trends in productivity and employment costs in the trunk airline industry
- Air carrier financial and traffic statistics and analyses
- Local service air carriers unit costs
- Origin-destination surveys/airline passenger traffic
- Studies of air freight rates
- Economic study of air freight forwarding
- Evaluations of fare structures and the effects of competition in selected areas.

e. Urban Mass Transportation Administration

1. Demonstration Programs

- Cleveland Extension
- Northwest Chicago — extension by bus of CTA to O'Hare
- Los Angeles Sky Lounge
- TACV in Los Angeles
- Dallas/Fort Worth intra-airport people-mover

2. Nontechnological

- VTOL for intraurban transportation

Source: Arthur D. Little, Inc.

APPENDIX D

1. LEGISLATION PERTINENT TO DOT AND NASA CIVIL AVIATION R&D

a. Background

A number of problems and deficiencies in the manner that DOT and NASA, respectively, administer and coordinate civil aviation R&D programs have been identified. In the analysis which follows, a few of these problems are examined in light of the legislation and legislative history behind DOT, NASA and their R&D programs. Congressional expectations and requirements in regard to civil aviation R&D programing within DOT and NASA respectively, coordination and cooperation between DOT and NASA civil aviation R&D efforts and overall civil aviation R&D management within the Executive will be considered.

Finally, there follows an examination of some policy issues which were considered when Congress revised and then enacted President Johnson's proposals for establishment of a Department of Transportation. The Hearings held by the House Committee on Government Operations revealed considerable concern about maintaining traditional Congressional appropriations oversight of the transportation programs of the individual modal administrations.

b. The Department of Transportation and Civil Aviation R&D

The Department of Transportation (DOT) was established pursuant to the Department of Transportation Act of 1966, 80 Stat. 931; 49 U.S.C. 1651. The Act is a revised version of President Johnson's proposal for a cabinet-level Department of Transportation consolidating various existing transportation agencies. The Johnson proposals and the DOT Act will be discussed more generally in Part e below. The discussion in this section is limited to portions of the proposal and the Act that concern civil aviation R&D.

Until passage of the Act, civil aviation R&D activities were limited essentially to NASA and FAA. However, neither NASA nor FAA expended significant portions of its budget on civil aviation R&D. NASA's involvement with aeronautical (as opposed to space) programs has been limited to basic research and advances in the state of the art. FAA's budget has been largely for operations. FAA's research has been confined to operational research principally in air traffic control. Other FAA R&D effort has been concerned with navigation and landing, aviation weather, and airports.

The President's message to Congress on the establishment of a Department of Transportation emphasized the need for much more research and development in the transportation field. He noted that at that time the Federal Government

was spending less than 1% of its total research and development budget for transportation. In stating the role of a Department of Transportation, the Administration indicated that the DOT would "bring new technology to a total transportation system, by promoting research and development in cooperation with private industry." Section 4(a) of the proposed bill provided, among other things, that the Secretary of DOT would "promote and undertake research and development in and among all modes of transportation and types of transportation services and facilities." The bill enacted by Congress retained the R&D activity in Section 4(a) and specifically mentioned aircraft noise abatement.

As requested by the Administration, the DOT Act made provision for four Assistant Secretaries. The precise duties of these Assistant Secretaries were not spelled out in the proposal or in the bill as eventually enacted. However, Administration witnesses and the House and Senate Government Operations Committees made it clear that one of the assistants would be concerned principally with research and technology. The language relative to aircraft noise abatement was added by Congress and reflected the concern of Congressmen that not enough was being done by FAA to relieve the noise problem.

The Administration witnesses, the Committee hearings, and the Committee reports on the bill emphasized that the modal administrations would be brought essentially intact within the new DOT. This point is discussed further in Part e but mentioned here because FAA had been conducting some limited R&D activities before the DOT Act. The point is that Congress expected FAA to continue its concern with R&D and did not want this activity placed in the Secretary's office. The House Committee Report on the bill indicated that language was added about noise abatement to place responsibility for that one particular R&D activity on the Secretary and indicate that aircraft noise abatement should be a major concern of the new department.

In the hearings before the House Committee on Government Operations on the DOT Act, the then FAA Administrator McKee testified that bringing FAA into the same department as other modal administrations should bring substantial R&D benefits. When pressed on specific examples, McKee mentioned joint airport access activities with the Bureau of Public Roads (BPR). Little, if any, of this modal coordination between FAA and BPR appears to have taken place.

c. NASA and NASC

The Aeronautics and Space Act of 1958, Declaration of Policy and Purpose, states in Section 102(b): "The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities . . . such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and

space activities sponsored by the United States, except . . . activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States . . . (c) The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

- The expansion of human knowledge of phenomena in the atmosphere and space;
- The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;
- The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;
- The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;
- The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.”

The National Aeronautics and Space Act of 1958, Public Law 85-568; 72 Statutes 426, 42 U.S.C. 2451 et. seq., as amended established the National Aeronautics and Space Administration (NASA). The Act sets out NASA’s three basic functions:

- Plan, direct and conduct aeronautical and space activities;
- Arrange for participation by the scientific community in certain aeronautical and space activities, and conduct or arrange for the conduct of these activities;
- Provide for the widest practicable and appropriate dissemination of information concerning its activities and results thereof.

Section 103 defines "aeronautical and space activities" and "aeronautical and space vehicles" broadly enough to allow NASA to become involved to an extensive degree in aviation research and activities. In fact, NASA has been most heavily involved with space exploration and by comparison has given only limited attention to aeronautics and aviation.

The National Aeronautics and Space Act of 1958 also created the National Aeronautics and Space Council (NASC). NASC, like NASA, has been primarily concerned with space and has given little attention to developing integrated policies, plans and programs in the fields of aeronautics and aviation. Neither the Secretary of Transportation nor the Administrator of FAA are members of the Council.

The first step toward directing NASC's attention to civil aviation would be to provide for membership of the FAA Administrator or the Secretary of DOT on the Council. This would require an amendment to the NASA Act, but seems quite logical. The logic has been recognized by the Hechler Committee and such a provision has been recommended by that Committee. As stated by the Hechler Committee, the exclusion of DOT from NASC despite DOT's principal responsibility for civil aviation should be viewed as a major defect in Government organization.

Even if the Secretary of DOT or the FAA Administrator becomes a statutory member of NASC, there is little reason to expect NASC to take the lead in insuring that civil aviation R&D activities are allocated most efficiently between NASA, the Office of the Secretary of DOT, and FAA. The NASC is basically an advisory body and there is little indication that it has played a significant role to date in shaping or rationalizing policies and programs. Executive Director Anders has indicated that he recognizes the need for a shift in attention to aviation and away from space; however, he has not yet acted as the catalyst for such a shift.

d. The Office of Science and Technology (OST)

President Kennedy established the Office of Science and Technology within the Executive Office of the President by Reorganization Plan No. 2 of 1962 in accordance with the Reorganization Act of 1949 as amended. The establishment of OST was the last in a series of steps undertaken during the Eisenhower and Kennedy Administrations to formalize the process of Presidential oversight of Federal policy relative to science and technology. At the time of submission of the plan for an OST, President Kennedy reviewed the various prior steps taken to improve organizational arrangements of the Executive branch in relation to science and technology:

- The National Science Foundation Act of 1950 created the National Science Foundation (NSF). NSF was "to develop and encourage a national policy for the promotion of basic research and education in the sciences, to support basic research, to evaluate programs undertaken by Federal agencies," etc.
- President Eisenhower created the Office of the Special Assistant to the President for Science and Technology in 1957. The Special Assistant is the President's personal adviser on matters related to science and technology, and serves as Chairman of the President's Science Advisory Committee and the Federal Council for Science and Technology.
- The Science Advisory Committee (established in 1951 in the Office of Defense Mobilization and composed of eminent nongovernment scientists and engineers) was reconstituted as the President's Science Advisory Committee and transferred to the White House effective December 1, 1957.
- The Federal Council for Science and Technology was established by Executive Order 10807 of March 13, 1959 to promote closer cooperation among Federal agencies, to facilitate resolution of common problems and to improve planning and management in science and technology, and to advise and assist the President regarding Federal programs affecting more than one agency. The council includes policy ranking officers of eleven departments as members, and representatives from seven additional agencies as observers.

The message submitting the OST proposal to Congress stressed the President's need for adequate staff support to help him develop policies and evaluate programs in order to assure that science and technology are used most effectively. President Kennedy indicated that although the National Science Foundation had been an effective instrument for administering programs in support of basic research and education in the sciences, it could not satisfactorily coordinate Federal science policies or evaluate programs of other agencies, because it was on the same organizational level as they were. He emphasized the need for evaluation and coordination at the level of the Executive Office.

Since inception OST has been headed by the Science Adviser to the President. The Director of OST serves as Chairman of the Federal Council for Science and Technology. The Council secretariat is provided by OST. Thus, the Science Adviser potentially can exercise considerable power and influence over the direction of Federal plans, policies and programs involving science and technology.

The possible role of OST in the area of civil aviation R&D is demonstrated by President Johnson's utilization of that Office to coordinate Federal efforts in the area of noise abatement in the mid-1960's. In the message to Congress on the proposed cabinet-level Department of Transportation, President Johnson stated that he was directing his Science Adviser to work with the Administrators of FAA and NASA, and the Secretaries of Commerce and HUD to frame an action program to attack the problem of aircraft noise. However, this *ad hoc* effort by the Science Adviser and OST does not reflect a continuing concern for aeronautical research, but rather appears to point up the Science Adviser's role as "trouble-shooter." Aircraft noise was perceived to be an important problem in 1966 as it is now. Since there was no focus of responsibility for coordinated research into aircraft noise abatement, the President turned to his Science Adviser to mobilize and direct efforts. Passage of the Department of Transportation Act focused the attention of DOT on aircraft noise abatement. The Science Adviser and the OST seem to have dropped from the picture on this problem.

As noted in the discussion of the National Aeronautics and Space Council (NASC), the OST is not officially represented on the NASC. There is no evidence of a Presidential or Congressional intention that OST or its Director play a continuing role in aeronautical R&D.

There have been sporadic discussions over the years about the desirability of a Department of Science in the Federal Government which would have programmatic functions similar to but much more extensive than NSF. Whatever the merits of such a proposal, it is probably not desirable that OST have more than an advisory and investigative function. Real coordination of the various Federal science and technology concerns would require a cumbersome and highly fragmented staff. As presently constituted OST would not have the expertise to merit having any type of veto power over a specific R&D activity like civil aviation.

e. Certain Issues Raised by the DOT Act of 1966

At the time of consideration and enactment of the legislation creating a Department of Transportation, several issues bearing directly or indirectly on our study of institutional constraints on civil aviation R&D were raised. The issues discussed in this section are:

- Allocation of responsibilities between the Office of the Secretary of Transportation and FAA.
- Budget formulation responsibilities and representation at Congressional Committee hearings.
- Control over policy formulation – Office of the Secretary versus FAA.

Undoubtedly, the most basic issue considered by the Johnson Administration and Congress concerned retention of the relative independence and autonomy of the various transportation agencies once they were brought within DOT. Virtually every witness at the committee hearings emphasized the need to have strong and independent modal administrations. Although Administration spokesmen disclaimed any attempt to undermine the program authority of FAA and the other agencies, the committees which considered the bill felt that positive statements that agencies would be transferred intact were required. As enacted, the DOT Act contemplated that the various administrators would report as line officers directly to the Secretary.

All responsibilities under the FAA Act of 1958 would be transferred from the FAA Administrator to the Secretary intact and then delegated by the Secretary back to the FAA. The Secretary could not alter those concerns and responsibilities in any way. As stated by the House Government Operations Committee Report Subsection 4(b)(2), the Congressional intent on this matter was crystal-clear.

Congress was also very concerned that Section 7 of the proposed Act would undermine the relationship of Congress and the agencies relative to appropriations. Thus, the House Report stated "a basic premise that has guided the committee . . . is that the legislation should not change the relationship between the legislative and the executive branches of government in transportation matters. For example, it is the committee's intent that national transportation policies be adopted only through congressional action." Thus, Section 7 was revised in committee to exempt "grants-in-aid programs authorized by law" from the Secretary's control over investment standards and criteria. Furthermore, Section 4(b)(2) was added to make it clear that *the Secretary was not to revise any existing or adopt any new policy*. Congress intended to make it clear that the existing mechanisms for federal funding of highways, airport development, etc. were not to be tampered with.

As can be seen, Congress sought to insure that the transportation regulatory agencies remain relatively independent; that emphasis be placed on continuity of operations; that Congress maintain its traditional oversight of transportation agencies and budgets; and that such financing mechanisms as the Highway Trust Fund not be changed.

APPENDIX E

ANNOTATED COMPENDIUM OF LEGISLATION AND PROGRAMS RELATED TO AIRPORTS AND AIRPORT ACCESS

1. LEGISLATION

a. Airport and Airway Development Act of 1970

The Airport and Airway Development Act of 1970 is a comprehensive attempt by Congress to provide for the expansion and improvement of the airport and airway system in the United States. Included in the legislation is a relatively detailed statement of the financing of this task.

Section 2 of the Act provides that the Secretary of Transportation is to formulate and to recommend to Congress a National Transportation Policy for approval. Particular attention is to be given to:

- The coordinated development and improvement of all modes of transportation, with the priority which shall be assigned to the development and improvement of each mode of transportation; and
- The coordination of the recommendations made under this title relating to Airport and Airway development with all other recommendations to the Congress for the development and improvement of our national transportation system. This represents the first time that Congress has required a coordinated overall national transportation policy.

Section 12(b) of the Act requires that the Secretary, in formulating and revising the national airport system plan, take into consideration the relationship of each airport to the rest of the transportation system in the particular area, its relationship to the forecasted technological developments in aeronautics, and its relationship to the developments forecasted in other modes of intercity transportation.

The other subsections of Section 12 describe the various agencies with which the Secretary of Transportation is to consult in formulating his national airport system plan. Overall, Section 12 seems to represent a new understanding on Congress' part of the impact which airport and airway development in a particular area has upon the social, economic, and physical development of that area. Subsection 12(h)(2)(A) contains the only specific reference to ground access in the Act. This subsection details the duties of an Aviation Advisory Commission, which is to be established and appointed by the President. One of these duties is to make recommendations concerning land uses, ground access, airways, air service, and aircraft compatible with the national airport system plan.

Section 13(a) authorizes the Secretary to grant funds to planning agencies for airport system planning, and to public agencies for airport master planning. This rule represents the first time that FAA has been given funds to make grants specifically for airport planning. Section 13(c) directs the Secretary of Transportation to prescribe regulations governing the award and administration of these planning grants. It also requires that the Secretary of Transportation and the Secretary of Housing and Urban Development jointly develop procedures designed to preclude duplication of their respective planning assistance activities and to insure that such activities are effectively coordinated.

Section 14 is the basic section on the development program. It authorizes the Secretary of Transportation to make grants for airport development by grant agreements with sponsors in various areas.

Section 16 details the law relating to submission and approval of projects for airport development. Section 16(c)(1)(A) makes approval of a project conditional upon its being reasonably consistent with existing planning agency projects for development of the area where the airport is located. Subsection (c)(3) states that no airport development project may be approved unless the Secretary is satisfied that fair consideration is given to the interest of communities in or near which the project may be located. Subsection 4 directs the Secretary not to authorize any airport development project which he determines will have an adverse effect upon the environment, unless there is no feasible alternative. If such a project is approved there must be a finding in writing following a full and complete review that is to be a matter of record that no feasible and prudent alternative exists and that all possible steps have been taken to minimize the adverse effect.

Subsection 16(d)(1) requires that no airport development project be approved unless the public agencies sponsoring the project certify that the community has been afforded the opportunity for a public hearing. Subsection 16(e) requires that the governor of the state in which a project is to be located certify in writing that the project will comply with the proper air and water quality standards. Approval of the project is to be conditional upon compliance during construction and operation.

Subsection 16(f)(2) requires in case of a proposed new airport serving a nonmetropolitan area that the Secretary condition approval of the site of a project upon prior approval of the community or communities in which the airport is proposed to be located.

Subsection 20(b) prohibits the use of the Federal funds appropriated under this act for:

- The cost of construction of that part of an airport development project intended for use as a public parking facility for passenger automobiles; or
- The cost of construction, alteration, or repair of a hangar or of any part of an airport building except for those buildings or parts of buildings intended to house facilities or activities directly related to the safety of persons at the airport.

b. The Department of Transportation Act

The Department of Transportation Act of 1966 established the Department of Transportation (DOT) to be headed by a Secretary of Transportation. Section 3 brings the various modal administrations, such as the Federal Highway Administration and the Federal Aviation Administration, within DOT.

Section 4 of the Act states the duties and powers of the Secretary of Transportation. Subsection 4(f) directs the Secretary of DOT to “cooperate and consult with the Secretary of the Interior, Housing and Urban Development, and Agriculture, and with the states in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed.” Subsection 4(g) directs consultation and exchanges of information between the Secretaries of DOT and HUD, regarding their respective policies and activities. It further requires joint planning, research and other activities, and the coordination of assistance for local transportation projects.

Subsection 4(b)(2) of the Act made it clear that Congress did not intend the Secretary of DOT to adopt, revise or implement any transportation policies. Operating and program responsibilities were to remain with the various modal administrations brought into the new Department.

c. The Urban Mass Transportation Act of 1964

The Act “authorizes the Secretary of Transportation to provide additional assistance for the development of comprehensive and coordinated mass transportation systems, both public and private, in metropolitan and other areas.” As originally enacted, the Act vested urban mass transportation functions in the Administrator of the Housing and Home Finance Agency. The Department of Housing and Urban Development Act (1965) transferred those functions to the Secretary of HUD. In 1968, Reorganization Plan No. 2 transferred most urban mass transportation functions to the Secretary of Transportation.

Section 2(b) of the Act states that its purposes are:

- To assist in developing improved mass transportation facilities, equipment, techniques, and methods, with the cooperation of both public and private mass transportation companies;
- To encourage the planning and establishment of areawide urban mass transportation systems with the cooperation of public and private mass transportation companies; and
- To provide assistance to state and local governments and their instrumentalities in financing such systems, to be operated by public or private mass transportation companies as determined by local needs.

Section 3(a) of the Act authorizes grants on loans to assist states and local public bodies and agencies in financing capital improvements in mass transportation service in urban areas and in coordinating such service with highway and other transportation in such areas.

Section 4(a) requires a finding that facilities and equipment for which assistance is sought are needed for carrying out a program which is part of the comprehensively planned development of the urban area.

Section 6(b) provides for the funding of research, development and demonstration programs for new systems of urban transportation that will carry people and goods within metropolitan areas.

Section 8 requires consultation and an exchange of information between the Secretary of HUD and the Secretary of Transportation in order to assure rational transportation planning in urban areas.

d. Federal Aid to Highways

Federal aid to the states for highway construction dates back to the 1920's. *The Highway Act* established the Highway Trust Fund as a mechanism for financing Federal Aid to highways. The highway trust consists of revenues from the Federal tax levied on gasoline. Beginning with the original Highway Act, Congress authorized the Bureau of Public Roads (Secretary of Commerce) to allow a state to use 1½% of its share of the highway trust for highway research and planning if that state so requested. In reporting the Highway Act of 1962 and to the Senate floor, the Senate Committee on Public Works noted that in order to satisfy a need for additional highway research and planning Section 11 of the

1962 Act would amend Section 307 of the U.S. Code to limit the use of the 1½% funds to research and planning each year. Section 11 furthermore authorized the use of an additional ½ of 1% of a state's trust monies for planning and research if the state so requested.

Section 7 of the 1962 Act added a new Section 134 to Title 23 directing the Bureau of Public Roads (the legislation reads Secretary of Commerce) to cooperate with the states in the development of long-range highway plans and programs coordinated with plans for improvements of other affected forms of transportation. The Senate Committee on Public Works report of the bill indicates that the intent was to improve the quality of urban planning generally and encourage transportation planning specifically. The section also declared that it was in the national interest to encourage and promote the development of transportation systems.

Section 134 of the Act also required the establishment of so-called urban transportation studies in urban areas with populations of 50,000 or more. These were to be the local mechanisms for developing long-range highway plans and programs that would be coordinated with other forms of transportation and with land use plans for the area.

The 1962 Act also required that each assisted state establish a body for urban transportation planning.

The 1968 Highway Act established the so-called "highway topics program" which authorized the earmarking of Federal funds for the building of specified highway improvements.

e. Demonstration Cities and Metropolitan Development Act of 1966

This Act, which provided for the model cities program, among others, was generally designed to assist comprehensive city demonstration programs for rebuilding blighted areas and for providing for public facilities and services necessary to improve the general welfare of the people living in these areas, and to assist and encourage planned metropolitan development.

Title II of the Act is entitled "Planned Metropolitan Development" and sets out the Federal policies relative to the funding of areawide development programs. Section 201 sets out the findings and declaration of purpose relative to planned areawide development. It states that greater coordination of Federal programs and additional participation and cooperation from the states and localities are needed to effectively carry out such efforts. It continues that the purpose of the title is to provide, through greater coordination of Federal programs and supplementary grants through certain Federally-assisted development projects,

additional encouragement and assistance to states and localities for making comprehensive areawide planning and programming effective.

Section 202(2) directs that all Federal agencies which are engaged in administering to programs related to areawide development or which otherwise perform functions relating thereto, to the maximum extent practicable, consult with and seek the advice of all other significantly affected Federal departments and agencies — a method to insure fully coordinated programs. To this end Section 203 provides for the appointment of a “Metropolitan Expediter” for a given area, whenever the Secretary of HUD finds a need for a person to provide information, data, and assistance to local authorities, private individuals and entities within the metropolitan area, and to all relevant Federal departments and agencies with respect to all programs and activities conducted by HUD in the area.

Section 204 is particularly important, because it requires that applications for Federal funds or grants for the planning and construction of various capital facilities including airports, highways, and other transportation facilities within any metropolitan area be submitted for review and comment by an areawide agency designated to perform metropolitan or regional planning. However, this procedure merely calls for comment primarily concerning the extent to which the application is consistent to the area’s comprehensive plan. Since many areas do not have completed comprehensive plans or only have very inadequate ones, this procedure is not very meaningful. The relatively *pro forma* nature of this process was readily conceded by Federal officials interviewed.

Section 205 authorizes HUD to make supplementary grants to applicant, state, and local public parties and agencies carrying out or insisting on carrying out metropolitan development projects. However, grants may be made under this section only for metropolitan development projects in those areas which meet certain criteria to the satisfaction of the Secretary. These criteria are:

- That there exist areawide comprehensive planning and programming which provide an adequate basis for evaluating eligible projects; and
- That there be adequate areawide-institutional (or other) arrangements for coordinating, on the basis of such areawide comprehensive planning and programming, local public parties and activities affecting the development of the area;

Subsection 205(b)(1) requires that where the applicant for a grant is a unit of general local government, it must satisfy HUD that it is adequately assuring that public facilities projects and other land development or uses of public areawide or interjurisdictional significance are being, and will be, carried out in

accord with metropolitan planning and programming, meeting the requirements of Subsection b. Particular attention is supposed to be paid to whether the applicant, local government unit is effectively assisting in conforming to metropolitan planning and programming through:

- The location and scheduling of public facility projects whether or not Federally assisted; and
- The establishment and consistent administration of zoning codes, subdivision regulations, and similar land use and density control.

f. Senate 2425 – The National Transportation Act of 1969

This Bill was introduced in the Senate by Senators Magnuson, Hart, Hartke, Long, and Pearson. The preamble to the bill states that its purpose is “To authorize the Secretary of Transportation to provide for a long-range program of comprehensive regional planning for, and in coordination of, transportation, including therein the undertaking of research and development and the conducting of demonstrations, and for other purposes.”

Section 2 details certain factual findings as to the need for such legislation, stated in terms of the benefits of a balanced and efficient transportation system on the general welfare, including preservation and enhancement of the environment, conservation of natural resources, and general improvement of the health and welfare of the society. The assumption is made that this can only be brought about by a systematic and coordinated long-range planning approach for transportation.

Section 3 states that the purpose of the Act is to provide for the planning and development of a balanced transportation system throughout the United States. The Section further states that the Act is designed to encourage, through the provision of Federal aid and support, coordinated transportation planning and development within and between various geographic and economic regions of the nation.

Section 4 directs the Secretary of Transportation to designate appropriate major transportation regions within the United States with the concurrence of the Governors of the various states and the authorized representative of the District of Columbia in which such regions would be located.

Section 5(a) directs the Secretary to encourage the states to establish regional commissions. Such commissions are to be similar if not identical to the existing regional commissions established under the Appalachian Regional Development

opment Act of 1964 and Title 5 of the Public Works and Development Act of 1965. The remainder of this section describes certain details of the establishment and administration of such commissions.

Section 6 outlines the functions of the regional commissions. The regional commissions are authorized to “develop plans, research and development programs, and demonstration projects of balanced and coordinated regional transportation development, and establish a priority ranking for such plans, programs and projects.” With respect to their planning function, the regional commissions are to:

- initiate and coordinate the preparation of long-range overall transportation plans for their regions, designating the priority of transportation needs of the various affected areas and identifying the transportation resources of the affected areas;
- develop comprehensive and coordinated plans utilizing the long range overall transportation plan as a guide;
- relate transportation development to other planning and development activities and needs of the region, including the preservation and enhancement of the environment;
- prepare specific plans for the development of improved and compatible transportation systems within the region; and
- conduct investigations, research surveys and studies to provide data for the preparation of plans.

With respect to their research and development programs the regions are to initiate:

- research and development of intercity systems aimed at immediate improvements in intercity passenger service using existing facilities and available equipment;
- research and development for safe and reliable high-speed prototype intercity passenger systems;
- research and development of equipment used in urban areas to provide at an early data a prototype demonstration system providing high-speed passenger transportation in such areas;
- R&D of transportation systems that provide compatibility between urban and intercity systems; or

- R&D of other transportation systems essential to the needs of the affected area.

Demonstration projects are to reflect the priority of the transportation needs of the affected area as determined by the commission. The commissions are directed to cooperate with the Federal, state and local agencies in conducting or sponsoring R&D programs and demonstration projects in connection with regional transportation needs.

The regions are also given various other coordinating and recommending responsibilities, i.e., formulating and recommending where appropriate, inter-regional contacts and other forms of interstate and interregional cooperation for carrying out recommended programs for improved transportation, and working with Federal, state and local agencies in developing an appropriate model legislation.

Section 7 details the administrative powers of the regional commissions. Subsection (a) essentially gives these commissions the same sorts of powers that existing regional commissions had been given by Federal legislation. Subsection (b) adds a duty for such commissions to hold hearings and take testimony where deemed advisable.

Section 11 outlines the manner in which Federal financial assistance is to be distributed to the regions:

- One-third of the ratio which the total area of each region bears to the total area of all regions; one-third of the ratio which the total population bears to the total population of all the regions as shown by the latest Federal census; and one-third of the ratio which the population and the municipalities and other urban places of 5,000 or more in each region bears to the total population and municipalities in other urban places of 5,000 or more in all the regions as shown in the latest available Federal census.

Subsection B limits the total Federal contribution to the cost of any planned program or project to 90%.

The remaining sections deal with administrative details.

The Senate Commerce Committee chaired by Senator Magnuson held hearings on this bill (the National Transportation Act of 1969) early in 1970. At the opening of these hearings, Magnuson emphasized the necessity of examining a number of assumptions which lay behind the legislation. These assumptions were:

- That our present transportation system is not really a system at all, but rather a combination of various subsystems that bear little or no relation to one another;
- That this 'non-system' is costly to the country in terms of the environment and social welfare as well as the traffic congestion is evident in all modes of transport;
- That technological solutions to our urban and interurban transportation problems have been or can be developed; and
- That rational implementation of such solutions requires an appropriate political framework within which transportation policy can be made, and that such a framework does not now exist.

The most important witness before the Senate Commerce Committee was John Volpe, Secretary of Transportation. He went on record as opposed to the National Transportation Act of 1969 at that time. His testimony suggested that he had little or no argument with the four assumptions outlined above, but he felt that Senate 2425 would only complicate and confuse attempts to develop a balanced transportation system. Secretary Volpe's most basic point seemed to be that since the new legislation would not eliminate the range of uncertainties and unattractive features of the present planning and development process, there could be no point in setting up new organizations and duplicate bureaucracies.

Perhaps Secretary Volpe's most telling point was that Senate 2425 does not in any way affect the problems associated with channeling Federal assistance through separate modal administrations. He admitted that the creation of the Department of Transportation was in itself a recognition of the need to coordinate the several Federal transportation grant-in-aid programs. Secretary Volpe implied that he questioned the wisdom of continuing the modal basis for grant programs and the planning associated with such programs but, stopping short of criticizing the separate modal arrangement, he identified DOT's basic task as obtaining coordination within a modal framework. He also supported a "transportation trust" by observing "that the development and implementation of inter-modal plans can never be wholly successful without much more flexibility in the allocation of investment funds among the various modes of transportation."

g. The Appalachian Regional Development Act of 1965

The Act establishes the Appalachian Regional Commission to administer a program of Federal aid for the economic development of the Appalachian region. Section 214(c) was amended by the Airport and Airway Development Act of 1970 to bring the airport development program within the scheme of Appalachian Federal grants in-aid.

h. The Public Works and Economic Development Act of 1965

The basic purpose of the Public Works and Economic Development Act of 1965 was to provide new industry and permanent jobs in distressed areas through such aids as grants or loans for public works and development facilities for businesses and development companies, and grants for technical assistance, research, and information. The emphasis of the Act is on long-range economic development and programming for areas and communities with persistent unemployment and low family incomes.

The Act establishes a framework for administering Federal assistance to depressed areas through the Economic Development Administration of the Department of Commerce. State and local public agencies and private or public nonprofit organizations representing a redevelopment area or an Economic Development Center are eligible to receive grants.

Title V of the Act establishes five joint Federal-state organizations called Regional Commissions. These Regional Commissions are charged with developing comprehensive, long-range economic development plans for their respective designated multistate development areas. Like the Appalachian Regional Commission, the bodies established under this Act are made eligible to receive airport planning funds under the Airport and Airway Development Act of 1970.

2. PROGRAMS

a. Programs of the Department of Transportation

Programs discussed in this section are UMTA's capital assistance research, development and demonstrations, and technical studies grants programs; the Bureau of Public Roads highway planning and construction and highway studies programs; and the FAA's Federal-Aid-to-Airports Program.

UMTA provides grants or loans to public bodies for acquiring or improving capital equipment and facilities needed for publicly and privately operated mass transit systems. Only public bodies are eligible recipients. UMTA awards research, development, and demonstration project funds in response to proposals from public bodies, universities, or organizations with research capabilities in urban transportation. Even if authorized funding were greatly expanded it seems unlikely that this type of demonstration program could play a major role in comprehensive transportation planning and development for an area. At the present time, few of UMTA's projects under this program bear upon airport access or ground transportation in or around the airport. Where such projects are airport-related such as in the case of the Dallas-Fort Worth people-mover, UMTA's motivation for the award had less to do with improving airport access than with testing a concept at a convenient place. Thus, one government official stated that the primary reason the people-mover project was undertaken at Dallas airport was that the political difficulties of operating within a city made the airport a more convenient location.

UMTA technical studies grants are available to assist public agencies for up to two-thirds the cost of system planning, design, engineering, and other technical studies — as long as the objective is a unified, coordinated urban transportation system which is part of a comprehensive community development plan. Only public bodies are eligible recipients. The technical studies grants program is a logical one for coordination and joint planning with FAA on airport access planning. However, UMTA is basically responsive to proposals from local bodies and has no planning function of its own. It does fund airport access by mass transit studies under this program but tends to view the access problem as a lower priority need. Thus UMTA very seldom, if ever, takes the lead in encouraging local organizations to do airport access studies.

Until the recent passage of the Airport and Airways Development Act of 1970, the basic program of Federal assistance for airport development was the *Federal-Aid-to-Airports Program* (FAAP) administered by the Federal Aviation Administration (FAA). This program, established by the Federal Airport Act of 1946, as amended, is designed to furnish financial aid and technical assistance to public agencies in the planning, acquisition and development of public airports as part of an adequate nationwide system of airports. Provision for the conveyance of Federal lands and surplus properties under certain circumstances, where needed to carry out an airport project, or for the operation of a public airport is made, pursuant to the *Federal Airport Act* and the *Federal Surplus Property Act of 1944*.

Prior to the 1970 Act, Federal support of airport master planning at the local level had been essentially nonexistent, except for approving the adequacy of a sponsor's plan. The Federal activity rested in grants-in-aid for airport facilities construction including: land acquisition; site preparation; construction, alteration, and repair of runways, taxiways, aprons, and roads within airport boundaries; and construction and installation of lighting, utilities, and certain other on- and off-site work.

The FAA had no authority to aid in airport access planning or development. This situation will, of course, continue under the new Act. As noted above, FAA did recognize the impact of access roadways on the airport development effort. In fact, area officials of FAA were directed in 1966 to consult with the Bureau of Public Roads officials and State Highway Departments and/or Section 134 (Highway Act) urban transportation studies concerning roadway planning near airports. Indications are that this directive was not followed very closely. The decentralized administration of FAA and FHWA programming makes it unlikely that recognition of the airport access problem by Washington officials will necessarily ensure active efforts to resolve it. In fact, the field office structure of the two agencies is not complementary.

Pursuant to the various Federal highway aids acts, the Bureau of Public Roads of the Federal Highway Administration (FHWA) provides financial assistance to state highway departments for constructing the interstate highway system and for building or improving primary and secondary roads and streets. Congress has authorized funds to be proportioned from the highway trust to the states and to be matched on a 90% Federal, 10% state basis for the interstate system and 50-50 for other projects. These funds may be used for planning, engineering, right-of-way, acquisition, construction, improvement, roadside beautification, recreation and rest areas. The program is administered in such a way that each state highway department has considerable autonomy in determining what types of projects should be undertaken. The Bureau of Public Roads planning officials suggest that to the extent that airport access roadways have been neglected or provided for only incidentally, there was obviously a decision on the part of the State Highway Department that such roadways were not a high priority. The Bureau of Public Roads has consistently emphasized the need for a state highway department to initiate improvements in a particular part of its system.

Administratively, the Bureau of Public Roads is organized so that a local Bureau of Public Roads official has day-to-day contact with the state highway department in his area. Thus, there is obvious opportunity and potential for the field staff of the Bureau of Public Roads to make certain that airport access considerations are kept in mind when highway planning is undertaken at the state level. Moreover, although the Federal Aviation Administration field staff is

organized along different lines than that of the Bureau of Public Roads, considerable opportunity does exist for coordination and consultation between the Bureau of Public Roads officials and FAA field staff. Both the FAA and the Bureau of Public Roads in Washington admit quite readily that very little such coordination has taken place despite circular memoranda that have been distributed to their respective agency staffs since the early 1960's.

As noted, Section 134 of the Federal Highway Act of 1962 required the establishment of urban transportation studies in areas of 50,000 or more persons as a condition for receiving Federal highway planning funds. The Bureau of Public Roads field staff was directed to include a representative of the management of each airport in the area and a representative of the area office of the Federal Aviation Administration, on the technical committees of such urban transportation study groups. In fact, the directive was not always followed. As recognized by the Bureau of Public Roads and FAA officials in Washington, the Section 134 urban studies groups offered excellent vehicles for planning and developing airport access roadways. To the extent that such roadway planning and development has been inadequate, the fault may lie with the field staffs of the administration involved, since Federal highway planning funds are fairly readily available and such Section 134 study groups exist in just about every area. Furthermore, it seems clear that exercising the "carrot" or "stick" of Federal funding could permit field staffs to exercise considerable influence over the planning and project development of state and highway departments.

On the other hand, it did take legislation to get the Bureau of Public Roads to encourage state highway departments to pay greater attention to the significant problems of urban transportation and roadway construction. Since political power at the state highway department level often rested with the less urban areas of the State, a fair share of Federal monies was not being channeled toward urban concerns until an enactment of the "highway topics" program under the Federal Highway Act of 1968. Under this program, a portion of the funds must be earmarked by the Bureau of Public Roads for certain urban uses. However, there was no provision for earmarking funds for airport access.

b. Programs of the Department of Housing and Urban Development (HUD)

In the past HUD has been involved with airports on the planning side essentially under (1) the "701" Comprehensive Planning Assistance Program, and (2) the Planned Metropolitan Development and Model Cities Programs.

Section 701 of the *Housing Act of 1954*, as amended, authorizes Federal aid for "comprehensive planning" that may include land use, community facilities, and transportation. Under the program, HUD has given grants to "701 planning bodies" of up to 2/3 the cost of an airport planning study as long as such a study was part of an overall comprehensive planning program. FAA has played a role in this program by encouraging FAAP sponsors to do this type of planning and coordinating with HUD to assure consideration of air transportation as an integral part of 701 plans. This has constituted FAA's major opportunity to become involved in the airport planning process beyond developing its own National Airport Plan and evaluating project applications in light of it. Airport planning assistance grants under the 701 program are to be replaced by the Section 13 program of the new *Airport and Airway Act*.

Title II of the *Demonstration Cities and Metropolitan Development Act* requires that Federal areawide planning and development programs be coordinated and to some extent packaged, so as to achieve maximum leverage from such programs in a given area. In fact, FAA has participated in this scheme only to the extent of passing project applications through A95 clearinghouse agencies and around other Federal agencies for comment and in turn commenting upon projects that have implications for airports.

c. Programs of the Department of Commerce

Department of Commerce programs related to comprehensive planning and development in particular areas are administered by the Economic Development Administration (EDA) within the Department and were established under the *Public Works and Economic Development Act of 1965*. That Act authorized various types of Federal assistance to flow into economically deprived areas. Eligible communities must be a part of one or more of three types of geographic groupings defined in Title IV of the act:

- Redeveloped Areas — counties, labor areas, or larger urban areas characterized by high unemployment or low family income (Section 401);
- Economic Development Districts — groupings of counties containing two or more redevelopment areas or nonredevelopment areas, organized to seek common solutions to common economic problems (Section 403); and
- Economic Development Regions — groupings of States or parts of States with particularly complex economic problems (Section 501).

States, local agencies and other nonprofit organizations representing a redevelopment area or an economic development center within an economic development district are eligible for Federal grants and/or loans under various terms to defray the cost of public works and development facilities.

Federal funding of research and planning activities is also provided under the Act through the Economic Development Administration of the Department of Commerce. Such funding is available to state planning agencies and jurisdictions designated as redevelopment areas or economic development districts. As indicated above, these jurisdictions may be single counties, labor areas, larger cities or multicounty districts characterized by economic depression as defined in the Act.

In the past, Federal assistance from EDA under the Act has been given to eligible airport sponsors under the Federal Aid to Airports Program (FAAP). Such airport development aid has been in the form of direct grants or grants supplementary to FAAP grants. According to FAA, direct grants have been made for certain developments, such as hangars or terminal buildings not eligible under the FAAP. A coordinating role for FAA with EDA is provided for in Section 603 of the Act. Such coordination would presumably take the form of aid in evaluating a sponsor's application. Supplementary grants have been for the purpose of supplying a portion of the sponsor's share of costs in a FAAP development or advance planning project and are administered directly by FAA after EDA transfers funds to DOT. Eligible planning bodies under the Act have qualified for airport planning funds in the past.

When airport planning agencies and/or airport project sponsors under the Airport and Airway Act are located in areas eligible for funding under one of these EDA programs, obvious opportunities exist for maximum leverage through coordination and program packaging by FAA and EDA.